ABSTRACTS

1 SOUTHERN CALIFORNIA WETLAND RECOVERY PROJECT

Mary Small. State Coastal Conservancy

The Southern California Wetland Recovery Project (WRP) began in 1998 with the execution of an agreement that committed 17 state and federal agencies to develop and implement a regional plan for acquisition and restoration to increase the quantity and quality of the region's wetlands. The geographic scope of the WRP includes coastal wetlands and watersheds from Point Conception south to the U.S. Mexico border. The long-term objective of the WRP is to reestablish a mosaic of fully functioning wetlands systems, with a diversity of habitat types and connections to upland communities, which preserves and recovers self-sustaining populations of species. In the Regional Strategy, the WRP identified the following regional goals:

1. Preserve and restore coastal wetland ecosystems.
2. Preserve and restore stream corridors and wetland ecosystems in coastal watersheds.
3. Recover native habitat and species diversity.
4. Integrate wetlands recovery with other public objectives.
5. Promote education and compatible access related to coastal wetlands and watersheds.
6. Advance the science of wetlands restoration and management in Southern California.

To achieve these goals, the WRP has developed a broad-based partnership that includes 17 state and federal agencies working in concert with scientists, local governments, environmental organizations and business leaders. The WRP helps implement priority acquisition and restoration projects. In addition, the WRP awards small grants for projects that involve the public in hands-on restoration activities. The Science Advisory Panel of the WRP is developing a long-term, region-wide monitoring program for southern California wetlands and riparian areas.

2 BALLONA WETLANDS–COMMUNITY BASED RESTORATION PLANNING

Mary Small. State Coastal Conservancy

After more than thirty years of contentious land use dispute, last spring the State of California became the owner of more than 600 acres of the former Ballona Wetlands in Los Angeles. The site is near the mouth of Ballona Creek and is considered to be one of the best remaining opportunities for landscape-scale wetland restoration in Los Angeles County. However, there are significant constraints that may limit restoration activities, including existing infrastructure and easements. The restoration plan will seek to restore and enhance salt water influenced wetland habitat while also providing for wildlife-oriented public access and recreation opportunities where compatible. In September 2004, the State Coastal Conservancy, the California Department of Fish and Game and the State Lands Commission began a community based restoration planning process to develop a plan for interim site management and long-term enhancement of the property. The agencies have structured a planning process incorporates scientific input and is also transparent to all of the community's stakeholders. Restoration planning is expected to take up to three years.

3 ORMOND BEACH: RESTORATION OF HISTORIC WETLANDS

Peter Brand. State Coastal Conservancy

Ormond Beach is considered by wetland experts to be the most important wetland restoration opportunity in southern California. Prior to development, the coast of Ventura was a vast complex of dunes, lakes, lagoons, and salt and freshwater marshes. From the Santa Clara River estuary to the beginning of Mugu Lagoon, it appears from historic maps that there were seven lagoons. Most have either disappeared, been severely degraded, or been converted to marinas or ports. Nevertheless, this is the only place in southern California where it is still possible to restore close to the historic extent of wetlands.

The wetlands at Ormond Beach once covered approximately 1,000 acres; approximately 250 acres remain. The Coastal Conservancy has acquired 265 acres and expects to close soon on the acquisition of another 276 acres. The Conservancy has begun a restoration feasibility study for Ormond Beach

and adjoining wetlands that would show how this area could be restored and linked hydrologically and as an ecosystem. A critical mass of 750 acres of restored wetlands and associated habitat at Ormond Beach is expected to create a self-sustaining biological system and enough tidal prism and flushing action to maintain health and hydrologic function. Anticipated restoration at Ormond Beach would include modifications of the site hydrology to restore tidal action and bring back freshwater flows that had formerly drained across the Oxnard Plain to the coastal wetlands. When integrated with the adjoining 900 acres of freshwater wetlands and the 1,500 acres at Mugu Lagoon, this could be the largest coastal wetland in southern California, spanning nine miles of the coast from Point Hueneme to Point Mugu.

4 THE MALIBU LAGOON ENHANCEMENT PROJECT

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Malibu Lagoon is a 31 acre shallow water estuarine system that has been degraded by habitat encroachment and poor water quality. Previous restoration efforts led by California State Parks in the 1980's successfully restored some wetland habitat but did not adequately restore the natural structure and function to the estuarine ecosystem. The current configuration does not allow for adequate water circulation that, in addition to existing water quality impairments for nutrients and bacteria, promotes degraded water quality and habitat conditions. To address this situation, the California State Coastal Conservancy, in cooperation with California State Parks, has initiated the preparation of a restoration and enhancement plan for Malibu Lagoon.

This project identified and evaluated design options to restore the natural structure and function to the lagoon ecosystem, while minimizing impacts to existing brackish marsh habitat. All restoration options were designed to maintain existing access and increase opportunities for interpretation, education and stewardship for the 1.5 million annual visitors to the site. A collaborative approach directed by input from the Lagoon Technical Advisory Committee and the Lagoon Restoration Working Group was used to identify the restoration alternative that is expected to most readily achieve the biological and social goals of the project while introducing the least amount of impact to the existing lagoon ecosystem. A phased restoration implementation and long-term adaptive management approach will be implemented to maximize the ecosystem benefits of this restoration process.

5 ECOSYSTEM RESTORATION AT TIJUANA ESTUARY, CALIFORNIA

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Tijuana Estuary is a complex ecosystem that has been highly modified by human land use practices. The estuary is located entirely within San Diego County, California, although three fourths of its watershed is in Mexico. Unregulated land development within the Mexican portions of the watershed has resulted in an increased sediment supply throughout the watershed. As a result, sensitive wetland habitats have been buried, converting once productive salt marsh to ruderal upland habitats.

Management of the estuary is entrusted to a multi-agency Management Authority, which recognized the consequences of uncontrolled sediment deposition on the system. The Management Authority recommended two broad goals to reverse the trend of wetland loss: 1) Control sedimentation within the watershed, and 2) Restore areas degraded by sedimentation.

In the 1980's, the California State Coastal Conservancy initiated plans for controlling sediment and restoring the estuary. Working with Southwest Wetlands Interpretive Association, a non-profit organization, and Tierra Environmental Services the Conservancy has accomplished the following milestones:

- Constructed a 2.5-acre channel connecting formerly landlocked portions of the estuary to reduce sedimentation in backwater areas;
- Constructed a 20-acre Model Marsh project to restore intertidal salt marsh in an area subjected to disturbance;
- Constructed a series of managed sediment basins to control areas of high sediment deposition;
- Funded a study to restore approximate 250 acres of degraded habitat in the southern portion of the estuary.

These efforts have contributed to the reversal of human disturbance of the wetland; however, sediment continues to present management challenges.

6 RESTORING WETLANDS ON A GRASSROOTS LEVEL–NON-PROFITS AND WETLAND RESTORATION

D. Gibson. San Elijo Lagoon Conservancy Executive Director/Principal Scientist, Encinitas, CA 92023

The San Elijo Lagoon Conservancy (SELC) is a non-profit organization that began in 1987 out of concerns of development surrounding the San Elijo Lagoon Reserve. The organization built a membership of over 2,000 members and began educating its members. In 1995, the SELC hired an executive director with a scientific background and began conducting research and restoration projects. Currently, SELC maintains over 20 years of baseline data for water quality, fish, invertebrates, and bird data. SELC has raised over $10 million for projects and now employs 5 full time employees. SELC has written the San Elijo Lagoon Action Plan, which led to the baseline biological report for the full restoration of the lagoon for the Army Corps Of Engineers. This project encompasses moving infrastructure and removing past impacts to the system that have muted the tidal prism and changed habitat. SELC has also conducted studies that analyzed the sediment throughout the lagoon and are in the process of creating an Action Plan for the Escondido Creek Watershed, which drains into the San Elijo Lagoon. This past year we began one of the largest invasive species removal projects that have been funded by the State. The $4 million project will remove over 300 acres of invasive species from the riparian corridors of the Carlsbad Hydrologic Unit, of which the Escondido Creek watershed is a part. The SELC has been very successful in both restoring and enhancing habitat, as well as serving as a critical partner for federal, state and local government.

7 THE JOURNEY FROM WETLANDS TO OIL FIELD AND BACK

Jim Trout. State Lands Commission

The presentation will discuss the conversion of historic natural wetlands to commercial and oil field development and back to wetlands, all in a century.

Bolsa Chica lowlands in Huntington Beach, Orange County, were, in part, tide and submerged lands at the time of California statehood in 1850. A natural opening to the ocean existed near the current location of Warner Ave. and Pacific Coast Highway. This opening closed up after the lowlands were converted to farming operations and later into a duck-hunting club. In the 1950's oil was discovered the area and development of that resource was begun. The duck club was phased out while dikes, roads and oil drilling production pads were constructed in the lowlands. Oil continues to be produced from the lands today.

In the 1960's and '70's, attempts were made to develop the lowlands for residential housing. The upper area was built up into residential subdivisions. The lowland ownership was split into surface and mineral estates and efforts made to develop the surface for housing. Development in the lowlands was resisted by a number of environmental groups throughout 1970's and 1980's. A number of plans were considered but none were permitted.

In 1995, the ports of Long Beach and Los Angeles needed to mitigate for harbor fill required to expand their deep-water multi-modal marine terminals. Agreement was reached with state and federal agencies whereby the ports would pay for mitigation credits, the funds to be used to acquire and restore the Bolsa Chica lowlands. In 1997 the ports and eight state and federal agencies implementing the restoration effort signed an agreement.

The Agreement would fund acquisition 880 acres of the Bolsa Chica Lowlands (other than the subsurface mineral interests), purchase of the remaining production on 550 of those acres, abandonment of some oil and gas production facilities, and restoration of two-thirds of the area as wetlands, construction of a new inlet to the ocean with a new bridge over the inlet at Pacific Coast Highway. A full tidal regime would be established for 367 acres. Some 178 acres would have a muted tidal range, plus there will be nesting islands created for threatened and endangered birds as well as other amenities.

A number of public town meetings were conducted and an environmental impact document prepared, a restoration plan adopted and final plans and specifications completed. Proposals were solicited from contractors during June and July of 2004, contractor selection made during August. Work began in the field November 1, 2004. A formal groundbreaking was held on October 6 at the site. Completion is scheduled for the end of July 2006.

8 ENGINEERING OF THE BOLSA CHICA WETLANDS RESTORATION PROJECT

Chris Webb, Michael McCarthy, Moffatt & Nichol; Jack Fancher, U.S. Fish and Wildlife Service; and Keith Merkel, Merkel & Associates

The Bolsa Chica project is the largest salt marsh restoration project on the west coast, and represents the largest salt marsh restoration project by the USFWS. Eight government agencies forming the Steering Committee lead the effort, and a consulting team of five local firms performed the engineering for construction. Construction started last year and is rapidly progressing.

The project has been active for nearly 30 years. It consists of restoring the former Bolsa Chica wetland at the historic mouth of the Santa Ana River (prior to it shifting south to its existing position). The site is approximately 1,000 acres in size and lies immediately inland from Pacific Coast Highway just north of Huntington Beach. It represents a critical link along the Pacific Flyway for use by endangered birds such as the Western snowy plover and California least tern.

The project includes installation of a new ocean entrance stabilized by jetties that will connect to a deepwater basin will be dredged on approximately 365 acres contained by dikes, and will feed peripheral muted tidal areas over 200 acres through culverts in the dikes. New subtidal areas are being created for fish, mudflats and vegetated intertidal areas are being created for invertebrates and birds, and three new large nesting islands are being created for snowy plovers and least terns. Construction affects existing habitats, so other existing sensitive areas are being preserved and enhanced to offset effects for net benefits. Dredging will create a large mound of sandy fill in the shallow ocean off of the inlet, and beach nourishment along Bolsa Chica State Beach. New bridges are being constructed at the future inlet on Pacific Coast Highway and within the oil field. A significant groundwater control device is being installed along the project boundary nearest adjacent homes. Construction will last until 2007.

Challenges during construction include the extremely wet winter of 2004–05, sensitive species nesting in spring seasons of 2005 and 2006, and existing constraints related to oil field operation, use of the state beach, site clean-up activities, and other factors. These issues are addressed and related in the presentation.

9 USING SPATIALLY-EXPLICIT MODELS TO PREDICT EELGRASS DISTRIBUTION FOR RESOURCE MANAGEMENT AND RESTORATION

Robert Mooney. Merkel and Associates Inc.

A model that predicts potentially suitable eelgrass habitats was developed using eelgrass habitat requirements. The predictive model is a spatial, numerically-based, static habitat suitability index (HSI) model focusing on physical parameters that contribute to the observed distribution patterns of eelgrass. Data on eelgrass distribution, bathymetry, maximum orbital velocity, residence time, salinity, and hours of light saturation were combined to create the predictive model. Each spatially explicit theme was used to depict the range of environmental parameters affecting eelgrass distribution. The modeling framework used for the predictive eelgrass model was the Ecological Limits, Viability, and Sustainability (ELVS) model, which was originally developed by Merkel & Associates in order to make eelgrass habitat suitability predictions from bathymetric, hydrodynamic, and atmospheric data. This predictive model of suitable eelgrass habitat will provide resource managers improved capabilities to detect and track changes in eelgrass resources.

10 EVALUATING THE SUCCESS OF WETLAND MITIGATION IN LOS ANGELES AND VENTURA COUNTIES: ASSESSING PERMIT COMPLIANCE AND WETLAND CONDITION

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The Clean Water Act provides the most important protection of wetlands in the United States; an important element of this protection is the requirement for compensatory mitigation, by which wetland resources are created or restored to compensate for losses due to impacts to natural wetlands. In this study, we assessed 50 compensatory mitigation projects required by the Los Angeles Regional Water Quality Control Board in Los Angeles and Ventura Counties through an extensive review of permit files and field monitoring to map the area of the mitigation sites and assess (1) compliance with permit

conditions and (2) habitat condition. Twenty mitigation projects had multiple locations, yielding 79 individual mitigation site evaluations. A majority of the sites (69%) complied with all of their (assessable) permit conditions. Overall, the mitigation projects met their acreage requirements; omitting projects with undetermined boundaries, the total acreage lost in our assessment permits was 56 ha, the acreage required was 80 ha, and the acreage we measured was 91 ha. However, many of the mitigation sites did not have optimal wetland condition. Using a modified version of the California Rapid Assessment Methodology (CRAM), which assesses 15 different metrics in four main categories, we determined that 29% of the sites were in marginal to poor condition, 67% were of sub-optimal condition, and only three sites (4%) were in optimal condition. We conclude that the goal of no net loss of wetland functions and services has not been achieved in the Los Angeles region.

11 DEVELOPMENT OF AN INTEGRATED REGIONAL ASSESSMENT PROGRAM FOR SOUTHERN CALIFORNIA WETLANDS

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Historic and continued loss of wetland and riparian systems is one of southern California's most pressing natural resource management issues. In 1997, the southern California Wetlands Recovery Project (WRP) was formed to increase regional coordination of wetland preservation, restoration, and management among 17 state and federal agencies. As of September 2003, the WRP had spent of $61.8 million on 34 wetland acquisition, restoration and enhancement projects. However, the WRP currently lacks the ability to assess the progress of regional wetland ecosystem recovery, relative to continued wetland loss and degradation. To address this shortcoming, the WRP is developing an integrated wetlands regional assessment program (IWRAP) that will assess status and trends of wetland condition, measure recovery progress, evaluate the effect of anthropogenic stressors, and evaluate the effect of wetland management actions on the regional wetland ecosystem. The IWRAP will encompass all tidal and non-tidal wetland classes within southern California's coastal watersheds, and is based on a three-tiered assessment design: *Level I* assessment evaluates extent and distribution of wetlands and associated resources. *Level II* assessment evaluates wetland condition and stressors on a regional scale. *Level III* assessment addresses detailed management questions of stressors and condition on a site-specific scale. Key elements of the IWRAP are that 1) assessment questions are directly linked to management questions; 2) the intensity of a specific assessment is commensurate to the importance of the management question being addressed; 3) assessments are adaptive, and choices regarding special studies and other intensification efforts are informed by the results of coarser monitoring; 4) assessments are cost-effective, yet scientifically rigorous; and 5) project specific performance monitoring is consistent with ambient assessment. The estuarine component of the IWRAP includes 13 assessment questions that will evaluate wetland condition relative to areal extent, hydrology, sediments, contaminants, biota, and landscape context. When fully implemented, the IWRAP will streamline reporting of monitoring data, making them more accessible for routine scientific evaluation of restoration and management techniques, and will help to evaluate recovery priorities and ensure that WRP use of public funds has a lasting regional impact.

12 MONITORING PLAN FOR THE SAN DIEGUITO LAGOON RESTORATION PROJECT

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The San Dieguito Wetlands Restoration Project is required of Southern California Edison by the California Coastal Commission as mitigation for the operation of the San Onofre Nuclear Generating Station (SONGS). The restoration will consist of the creation of 115 acres of tidal wetlands with an additional 35 acres credit given for a commitment to maintain the lagoon inlet in an open condition in perpetuity. Habitats to be created in the restoration include subtidal, intertidal mudflat, coastal salt marsh, and transitional wetland. The success of the restoration will be evaluated using performance standards outlined in the Coastal Development Permit for the operation of SONGS. The restoration project is required to meet both physical (e.g., topography, water quality) and biological (e.g., fish, invertebrates, birds, vegetation) performance standards. A monitoring plan has been developed to guide the post-restoration monitoring work that will measure the success of the restoration project in achiev-

ing the performance standards. This plan includes the physical and biological performance standards on which the success of the restoration will be evaluated and recommended sampling methods for collecting the information needed to evaluate each standard. Key elements of monitoring program include independent monitoring and the use of reference sites in evaluating wetland performance.

13 QUANTIFYING THE PERFORMANCE OF DIFFERENT REEF DESIGNS ON KELP BED FISH AND BENTHIC COMMUNITY DEVELOPMENT AT THE SAN CLEMENTE EXPERIMENTAL ARTIFICIAL REEF

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Determining the success of an artificial reef as a tool for mitigating human-induced losses to fish populations and benthic communities requires explicit standards for assessing the performance of the reef and a robust monitoring program that is designed to collect the information necessary to evaluate those standards. The effects of material type (recycled concrete vs. quarry rock) and bottom coverage (30 to 90%) on fish and benthic community development were evaluated over a five year period in a large scale (~ 9 ha) artificial reef experiment off of San Clemente. Here we describe: 1) the biological performance standards established for kelp bed fishes and benthic communities on an artificial reef that will be built to compensate for the loss of kelp bed habitat caused by the operation of a coastal power plant in, San Onofre Nuclear Generating Station, Units 2&3 (SONGS); 2) an assessment of different methods of evaluating those standards; and 3) results of the five-year experiment that tested the efficacy of six different artificial reef designs in meeting these performance standards. Initial colonization by macroalgae was high on all reef designs. Overall, the abundance and species richness of macroalgae steadily declined over time while the abundance and species richness of sessile invertebrates steadily increased. The abundance of sessile invertebrates was positively correlated with the bottom coverage of reef material. The fish observations suggest that all six reef designs tested provide suitable habitat for kelp forest fishes and most likely would meet the SONGS performance standards for fish.

14 EVALUATION OF KELP (*MACROCYSTIS PYRIFERA* (L.) C. AGARDH) KELP RESTORATION OFF TAJIGUAS, CALIFORNIA USING SCATTEREDGRANITIC BOULDERS IN A SAND HABITAT

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The Tajiguas Kelp Habitat (TKH) was constructed May 6, 1999, in a 0.72 ha area offshore of Tajiguas, California at water depths between 8.5 and 10.4 m (MLLW). It's in relatively pristine waters (they receive minimal pollutants from urban development), sea otters are present occasionally, and casual observations over 20+ years indicate that *Macrocystis* juvenile recruitment events occur consistently. TKH performance satisfied California Coastal Commission mitigation requirements specifying construction of a new kelp habitat that would produce by November 2002, at least 470 adult plants living more than one year. In addition to meeting mitigation requirements, its performance is also meeting long-term criteria for creating a persistent kelp habitat by converting a sand habitat, where kelp persistence was low, into one that provides substrate for kelp recruitment and anchorage and that has minimal destructive sea urchin grazing problems. Design features to help meet long-term criteria, included: (1) Placing granitic rocks into sandy areas where the sand covering the bedrock was too shallow to allow complete rock burial. (2) Spacing rocks so, for the most part, they did not touch each other, thereby minimizing the number of habitats where sea urchins would be protected from predators. (3) Locating TKH adjacent to a natural kelp bed growing on bedrock that could provide TKH both a source of spores for recruitment, if artificial kelp propagation techniques failed, and sea urchin predators (invertebrate and fish) to help prevent destructive sea urchin grazing that occurs in other Tajiguas area kelp beds.

15 "FLOATING" BEHAVIOR OF GRANITIC BOULDERS USED TO CONSTRUCT THE TAJIGUAS KELP HABITAT ON A SAND PLAIN AND COMPARISON OF THE DEVELOPING EPIBIOTIC INVERTEBRATE ASSEMBLAGE WITH NEARBY NATURAL REEF ASSEMBLAGES

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Following removal of underwater pipelines through kelp beds in Santa Barbara County, we were asked to create an artificial kelp habitat offshore of Tajiguas. In response, the rocky 0.7 hectare Tajiguas Kelp Habitat (TKH) was constructed in a thin layer of sand over bedrock offshore from a natural kelp reef. Approximately 1,140 quarry rocks ≥0.6 m in diameter were scattered over the project area to provide ~16 percent of the seafloor. We monitored: "floating" behavior of 30 randomly selected rocks; and sand depth throughout TKH for 18 months. Recently, we conducted a 5-year survey to assess long-term conditions of the rocks and the epibiota.

In areas where sand overburden was less than 0.3 m deep prior to habitat construction, sand washed out and the introduced rocks were resting on exposed bedrock. In areas with deeper sand, the boulders were still basically "floating" on the sand. Thus, the rocks appear to provide long-term substrate suitable for kelp recruitment and survival.

The rich epibiotic assemblage that has developed on the rocks comprises a variety of primarily ephemeral suspension-feeding invertebrates dominated by bryozoans, hydroids, tunicates, and sponges. A comparison with the mature epibiota on nearby natural reefs suggests that the TKH epibiota is at an early stage of succession. Differences in species composition are probably driven by differences in disturbance, relief, and habitat "age".

Dense beds of large tubicolous polychaetes (*Diopatra ornata*) have developed in interstices among the rocks within TKH. These probably contribute more to fish biomass than any other species.

16 COMPARISON OF REEF FISH ASSEMBLAGES AMONG NATURAL ROCK HABITATS AND THE CREATED TAJIGUAS KELP HABITAT IN THE SANTA BARBARA CHANNEL

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Mitigation of natural resource damage may require directed restoration or creation of in-kind habitat. Typically, a mitigation project begins by manipulating abiotic factors (if necessary) at the targeted site and then establishing the foundation or architectural species, such as giant kelp, that defined the damaged habitat, with the expectation that missing species will have the potential to colonize the new habitat by natural or artificial means. To understand how reef fish assemblages responded to a created giant kelp habitat, we describe patterns of species composition and abundance at a manipulated area, the Tajiguas Kelp Habitat (TKH), and six reference sites within the Santa Barbara Channel region. The six reference sites represent a range of potential fish assemblages found within the study region, and were used to formulate simple "standing stock" performance measures to determine if TKH successfully met expectations. Performance measures included minimum levels of species richness and diversity, and whole-assemblage requirements based on degree of similarity to nearby versus distant reference sites. TKH met or exceeded all of these "standing stock" performance measures. Ideally, successful mitigation integrates the new habitat across larger temporal and spatial scales, emulating ecological trajectories (e.g. population dynamics, successional stages) of reference systems. These kinds of trajectories have not been measured at TKH, and require further investigation.

17 POSITIVE INDIRECT EFFECTS OF REEF FISHES ON GIANT KELP PERFORMANCE

Davenport, Andrew C. San Diego State University

Previous studies have suggested that microcarnivorous reef fishes may regulate or reduce grazing invertebrates, yielding positive indirect effects on giant kelp performance, thus preventing infestations that could have severe impacts or potentially destroy kelp forests. In 2003, I examined the effects of invertebrate herbivores on giant kelp performance in the presence and absence of their predators on plots of giant kelp in three treatments: predator access, predator exclusion, and a cage control. There was a significant increase in invertebrate herbivore density and an effect on kelp performance on plots

of giant kelp in which predators were excluded than on plots open to predators. Cage controls indicated that exclusion pens neither enhanced nor inhibited invertebrate herbivore densities or kelp performance. To determine if my results from the previous experiment apply to continuous reefs, I examined the effects of invertebrate herbivores on giant kelp performance in the presence and absence of their predators within a continuous kelp forest. In 2004, predator exclusion cages were deployed within a giant kelp forest and compared with designated open sections of the forest in a stratified random design with treatments at the edge, middle, and back of the kelp forest. There was a significant increase in invertebrate herbivore density and an effect on kelp performance within the continuous reef. In addition, invertebrate herbivores and microcarnivorous fishes were inversely related among nine kelp forests, suggesting that these effects may occur from small to large scales.

18 MARINE RESERVE DESIGN: DETERMINING AN OPTIMAL SIZE AND LOCATION

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"How big should a marine reserve be?" This is the most common question asked of MPA advocates whose replies are usually subjective based on an intuitive optimization of various objectives. A rule of thumb that 20–50% of targeted habitats should be protected within marine reserves has evolved over the last couple of decades based mainly on stock enhancement ideals for a few well-studied stocks. Here, we advocate a less subjective and more case specific approach based on the protection of critical habitat for entire sets of exploited species over an area large enough to protect individuals during their post-larval life stages. We have developed an algorithm to identify an optimal size and specific location for individual marine reserves based on the importance of habitat to all exploited species, the distribution of these habitats, and the post-recruitment mobility of these exploited species. We applied the algorithm to design an optimal marine reserve to protect twenty exploited species within the hard-bottom habitats of La Jolla, CA.

19 BEHAVIORAL THERMOREGUALTION OF THE LEOPARD SHARK (*TRIAKIS SEMIFACIATA*) IN THE NEARSHORE EMBAYMENTS OF SANTA CATALINA ISLAND, CALIFORNIA

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The leopard shark, *Triakis semifasciata,* is one of the most abundant nearshore elasmobranchs ranging from Baja California, Mexico to Oregon, with particular abundance in the bays of California. Mature female leopard sharks have been observed aggregating in Big Fisherman's Cove (BFC) Santa Catalina Island for over 100 years; however, it is unclear why females aggregate in these shallow areas. During July and August of 2003, the numbers of aggregating sharks were counted in different sections of the shallow embayment at BFC ($n = 36$, mean $\pm$ S.D. $= 21.52 \pm 8.17$) and water temperature was simultaneously monitored. Temperatures in the embayment ranged from 17.8–25.8C° (mean $\pm$ S.D. $= 21.8 \pm 1.2$). Sharks preferred the warmest areas of the embayment (correlation $r = 0.557$, $p<0.01$) and moved to warmer locations over the course of the day. In addition, acoustic tracking, acoustic monitoring and archival transponder technology (Vemco Ltd., V13, V13-R256, VX32TP-Chat tags respectively) are being used to monitor mature female sharks' body temperature, swimming depth, and movements at Catalina Island ($n = 16$). Acoustically monitored sharks show increased affinity to warmer shallow embayments around the island during the day than at night ($p = 0.01$). Preliminary results from archiving Chat tags suggest that shark body temperature is significantly warmer when in shallow water ($r = 0.43$, $p<0.01$), and that shark body temperature is warmer during the day than at night ($p = 0.01$). This form of behavioral thermoregulation may augment metabolic and physiological functions important for gestating females.

20 MOVEMENT PATTERNS AND HABITAT USE OF OCEAN WHITEFISH (BRANCHIOSTEGIDAE) IN A SANTA CATALINA ISLAND MARINE RESERVE

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Knowledge of fish movement patterns over varying temporal and spatial scales is essential for effective management of fish populations. This study integrates acoustic telemetry and a GIS to quantify movement patterns, home range, site fidelity, and habitat use of ocean whitefish (*Caulolatilus princeps*) at the Catalina Marine Life Refuge (CMLR) located at Santa Catalina Island, California. Ten individuals were tagged with acoustic pingers (2 month battery life) and actively tracked to measure fine-scale movements and home ranges over multiple 24hr periods. Home ranges based on 95% kernel utilization distributions range from 90–348,966 m^2, averaging 50,876 ± 110,094 m^2 (± SD). Individuals tracked were active during the day, using soft sediment habitats, but were inactive at night, taking refuge near rocky reefs. An additional seventeen fish were tagged with coded acoustic transmitters (1yr battery life), yielding continuous presence/absence information within and adjacent to the CMLR. To date (~8 months), 88% of the individuals acoustically monitored have shown longer-term fidelity to home ranges within the study site as well as consistent diurnal activity. Ocean whitefish home ranges extend beyond the reserve boundary, making this reserve less effective for protecting adult fish.

21 THE FISH ASSEMBLAGE OF AN ARTIFICIAL AND NATURAL REEF IN THE HORSESHOE KELP

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Horseshoe Kelp is an extensive fish habitat near the Port of Los Angeles composed of several substrates types, including low relief and high relief rocky reefs, *Laminaria* beds, and coarse sand bottoms. As a result of the Deep Draft Improvement Project conducted by the U.S. Army Corps of Engineers and the Harbor Department of the Port of Los Angeles, hard bottom habitat was lost along the northern edge of Horseshoe Kelp (USACE 1997). Due to its proximity to the port, commercial and sport fishers currently and historically have utilized this area extensively. In 2001, a mudstone fishing reef was added to mitigate lost hard bottom habitat in the Horseshoe kelp. The newly created Fishing Reef, a nearby rocky reef, and *Laminaria* reef control habitats were monitored continually between September 2001 and October 2004 using underwater visual census methods. Fish transects were completed on the Fishing reef, a natural reef and the *Laminaria* beds during each sampling period. This interim assessment found that the turbidity, which was noted after reef construction, caused difficulties for sampling, persisted through Fall 2003 and abated in Spring 2004. Fish density was significantly lower on the Fishing Reef than the rocky reef control, but not the *Laminaria* reef control. This is an indication that the Fishing Reef is continuing to mature. Nonetheless, important fishery species including kelp bass (*Paralabrax clathratus),* California sheephead (*Semicossyphus pulcher*), barred sand bass (*Paralabrax nebulifer*), lingcod (*Ophiodon elongatus*), California scorpionfish (*Scorpaena guttata*) and calico, gopher and vermilion rockfishes (*Sebastes* spp.) were found on the newly created Fishing Reef.

22 EFFECTS ON NEARSHORE ROCKY REEFS FOLLOWING THE REGIONAL BEACH SAND PROJECT

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Over the past two decades, San Diego's shoreline has experienced chronic and continuing erosion. In an effort to restore many of the beaches, in 2001, SANDAG implemented the Regional Beach Sand Project which dredged just over two million cubic yards of sand from four offshore borrow sites and replenished 12 beaches along the coast of San Diego County. Concern from resource agencies and

commercial fishermen regarding the potential for the sand placed on the beaches to impact nearby reefs promulgated monitoring of rocky intertidal, shallow subtidal, and kelp forest habitats in the vicinity of select receiver sites. Since implementation, there has been varied response and this presentation will discuss four years of shallow subtidal and beach profile monitoring data regarding coastal processes and its effect on nearshore reefs.

23 EVALUATION OF EELGRASS MITIGATION AND FISHERY ENHANCEMENT STRUCTURES IN SAN DIEGO BAY, CALIFORNIA

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In 1997 to offset habitat loss and increase fishery production an eelgrass mitigation habitat was completed in San Diego Bay, California. This mitigation effort consisted of the transplantation of eelgrass, *Zostera marina,* in the lower portion of the bay. In addition to the establishment of a new eelgrass bed, four artificial reefs made of either quarry rock or concrete were created to further enhance fishery stocks and area's ecosystem. Two design criteria and a direct comparison between quarry rock and concrete reefs were examined in this pilot program. These rocky-reefs and eelgrass habitats were monitored for five years by scuba. The newly created eelgrass habitat quickly performed at the level of the existing eelgrass bed and the overall analysis found that the mitigation eelgrass habitat was not significantly different from the reference eelgrass habitat in terms of fishes. Neither reef material (quarry rock or concrete) nor original reef design influenced fish utilization. In addition, aspects of fishery enhancement were examined using three species of rock bass from the genus *Paralabrax* (Perciformes: Serranidae). All age classes of kelp bass, *Paralabrax clathratus,* were present throughout the study. The density and distribution spotted bay bass, *P. maculatofasciatus,* indicated they utilized these enhancement reefs for foraging. Finally each age class of barred sand bass, *P. nebulifer,* significantly predicted the subsequent age class. This indicates that these modules were successfully in providing habitat for recruitment and subsequent development through adulthood. Using artificial reefs and eelgrass transplantation, enhancement and mitigation goals were achieved in San Diego Bay.

24 LESSONS LEARNED, A HALF-CENTURY OF GIANT KELP RESTORATION IN SOUTHERN CALIFORNIA

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In the late-1950s attention was drawn to the loss of several kelp beds up and down the coast of southern California. Investigators such as Dr. Wheeler J. North began early investigations into the cause of the loss of kelp beds. These early investigations focused on the sometimes subtle effects of mans encroachment on the environment. Searching for answers, Dr. North found the unhealthy kelp beds infested with urchins, but urchins were normal in other kelp beds and did not cause substantial problems. Dr. North and his colleague Dr. Mary Clark, research scientists at CalTech determined that the interaction of sea urchins and sewage was responsible. With the determination that urchins were a large part of the equation in the disappearance of certain kelp beds, methodologies were sought to eliminate excess urchin populations and restore the kelp beds. Unrecognized in the early 1950s and 1960s, the effects of El Ninos and La Ninas also showed the role they play in the viability of our coastal kelp beds.

Two basic techniques were pioneered by Dr. North to restore kelp beds. These include the transplantion of juvenile, subadult, and adult kelp from existing beds using several techniques for attachment and the laboratory growth of sporophytes and their outplanting. Both methodologies have been used successfully but can have vastly different results depending on the ecological interactions in the area being restored.

One of the criticisms of restoration efforts is that it is a non-issue and that natural cycles will take care of the problem, some years are good and some are bad for kelp. We will explore this issue in relation to the probability of its applicability. Another criticism is that most of the growth of the restoration site is from natural revegetation, and that transplant efforts only contributed a minuscule portion of the kelp now present at the site. We will also determine if this criticism is credible.

We will look at several giant kelp restoration projects conducted in the past half-century to glean lessons to use to determine whether, where, and even if, giant kelp restoration projects should be attempted as a viable option today.

25 GIANT KELP RESTORATION AND MONITORING IN SANTA MONICA BAY

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Giant Kelp, *Macrocystis pyrifera,* is a large brown algae that forms canopies, on the oceans surface. These algal beds provide bio-genic structure that attracts a great diversity of organisms. Persistent anthropogenic pressures and changes in oceanographic regimes have reduced the aerial extent of kelp communities within Santa Monica Bay. Historic kelp beds are restored through sea urchin relocation, sporophyll bag deployment, transplanting drifting kelp and outplanting laboratory cultured kelp. Monitoring is performed annually on reference, control, and restoration sites. Quadrat and band transect methods are used to determine the density and diversity of a suite of benthic organisms within these sites. Roving fish counts, adapted from REEF are used to determine the density and diversity of fishes within the same sites. To date 4,500 square meters of rocky reef have been restored into a giant kelp bed off of Malibu. Early data indicates the formation of kelp canopy within 8 months of the initiation of kelp restoration. Increases in the density of fish by 10 to 100 fold have been described. Increases in the diversity of fish species has increased by 18%. This project incorporates volunteers who are trained to assist project biologists with the restoration and monitoring.

26 COMPARISON OF DIGESTIVE ENZYME ACTIVITIES IN TUNAS AND THEIR ECTOTHERMIC RELATIVES

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Tunas are known to elevate the temperature of their aerobic locomotor muscle, and some tuna species can also maintain elevated visceral temperatures. Tunas are effective predators, swim continuously, and have high metabolic rates. Their diet consists primarily of large quantities of protein and lipids. In tunas, the largest visceral organ is the caecal mass, which is thought to increase the surface area for digestion and absorption. This study was a comparison of digestive enzyme activities in tunas and their close ectothermic relatives, to test the hypothesis that enzyme activities are greater in the endothermic tunas. Two tuna species [yellowfin tuna (*Thunnus albacares*), a species that warms its muscle but not its viscera, and albacore tuna (*Thunnus alalunga*), a species that warms both the muscle and viscera] were compared with the ectothermic chub mackerel (*Scomber japonicus*) and eastern Pacific bonito (*Sarda chiliensis*). The specific activities of pepsin in the stomach and lipase in the caecal mass and intestine were measured at 15°C and 25°C and trypsin in the intestine and caecal mass were measured at 20°C and 25°C, with spectrophotometric assays. It was predicted that the caecal mass of endothermic species would exhibit higher digestive enzyme activities than that of non-endothermic species. High enzymatic activities in the caecal mass would support its importance in digestion. If enzymatic activities were significantly higher in the endothermic albacore at its elevated visceral temperature, this would suggest elevated visceral temperatures is likely to speed up processes of absorption and digestion.

27 STRUCTURAL COMPLEXITY OF SEAGRASS INFLUENCES PATTERNS OF RECRUITMENT OF FISHES IN SAN DIEGO BAY

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Processes affecting recruitment are important determinants of population structure and dynamics in marine fishes. Habitat structural complexity may influence recruitment success by providing refuges from predators, enhancing food availability, and influencing settlement by moderating current flow or velocity. The goal of this project was to determine how differential structural complexity of the eelgrass *Zostera marina,* an abundant habitat in San Diego Bay, influenced recruitment of fishes. We cross-factored shoot density with shoot height with standardized habitats in deploying artificial seagrass units (ASUs) at several sites within the bay. Recruits of all fishes were collected after 2-wk periods in each of 5 trials. Approximately 250 recruits from 12 species were collected. Recruitment among the six more abundant species revealed differential responses to habitat structural complexity, with

recruitment varying with shoot height, shoot density, and with no difference among treatments. We also conducted an experiment to determine whether predators moderated the abundance of recruits in treatments of predator access and exclusion, using a standardized shoot height and density. There was no significant difference in recruitment to predator access, predator exclusion and cage control treatments. Taken together, the results of these experiments reveal species-specific responses to seagrass habitat structural complexity that appears to be more a result of habitat selection than post-settlement predation.

28 TRANSITIVITY AND SONG PREFERENCES IN THE HOUSE CRICKET, *ACHETA DOMESTICUS*

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Understanding how animals choose between alternative options is a fundamental problem in behavioral ecology. Traditionally, models of decision-making utilized in animal behavior have assumed rationality and value maximization. In other words, individuals have complete ranking of all of their options and have infinite processing time and power to differentiate among them. Few, if any, studies have examined if these assumptions hold in the context of mate choice and none have been done utilizing invertebrates. Male crickets utilize relatively simple signals made up of repeated pulses of sound to attract females. In this study, we tested the hypothesis that female *Acheta domesticus* exhibit transitivity with regard to song choice. That is, given that a female prefers song a to song b and song b to c, they should prefer song a to song c. We tested this hypothesis using a binary choice apparatus and 3 songs that differed in the number of pulses per chirp and chirp rate. We tested the preference of individual females for song 1 versus song 2, song 1 versus song 3 and song 2 versus song 3. Females generally preferred songs with higher chirp rates but female choices did not exhibit transitivity. That is, an individual females preference for one song over another could not be predicted based on previous choices. These data suggest that females are not utilizing a decision-making process grounded in principles of value maximization and rationality as has been previously assumed.

29 ACOUSTIC TRACKING AND MONITORING OF CULTURED JUVENILE WHITE SEABASS RELEASED INTO SOUTHERN CALIFORNIA EMBAYMENTS

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Since 1986 over one million cultured white seabass, *Atractoscion nobilis,* have been tagged and released in southern California as part of the Ocean Resources Enhancement and Hatchery Program. Just over 1,200 of these fish have been recovered through various sampling methods. However, only limited information regarding the short term movement patterns and survival of cultured seabass is known from these results. To increase our understanding of these processes, we surgically implanted acoustic pingers in the peritoneal cavity of 58 cultured white seabass ($\bar{X}$ SL = 27 cm) during the past three years. After surgery, fish were held in captivity for 2–5 weeks to assess their healing prior to release. Acoustically tagged seabass were released as part of a larger group of cultured fish into several embayments within southern California. The fish were tracked actively from a small vessel and passively using an array of moored hydrophones. Emigration rates from embayments ranged from 37 to 57%, with most of these individuals leaving the embayment by the fifth day after release. Mortality rates were inferred from tags recovered from the sea floor. Mortality during the first month following release ranged from 20 to 40%. Strong circumstantial evidence suggested that top predators of cultured white seabass include birds, harbor seals, and octopuses. Of the seabass that were last heard from in embayments, 26 % were ultimately unaccounted for.

30 LACTATE PROCESSING IN ENDOTHERMIC AND ECTOTHERMIC SHARKS

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When sharks burst rapidly for prey capture or predator avoidance they undergo anaerobic metabolism in their fast-glycolytic white muscle (WM), producing lactate. The endothermic mako shark has a higher capacity to produce lactate than the ectothermic leopard shark; therefore it should process

lactate at a higher rate. There is evidence that most of the lactate is reconverted to glycogen within teleost fish WM, but lactate processing has not been examined in sharks. The shortfin mako shark (*Isurus oxyrinchus)* was compared with the leopard shark (*Triakis semifasciata*) to test the following hypotheses: (1) the mako shark will have higher activities of enzymes required for glycogen synthesis (pyruvate carboxylase-PC, phosphoenolpyruvate carboxykinase-PEPCK, malic enzyme-ME, and fructose-1,6-bisphosphatase-FBPase) in WM than the leopard shark and (2) within each species, activities of these enzymes will be higher in WM than in liver, heart, or red muscle. Lactate dehydrogenase activity (an index of lactate production) in WM was higher in the mako than in the leopard shark, as expected. Neither PC nor PEPCK activity was detected in WM, and there were no significant interspecific differences in FBPase or ME activity. PEPCK activity in liver was significantly higher in the mako. The only significant difference among tissues was that mako PEPCK was higher in the liver than in the heart. Therefore, neither hypothesis was supported. The results indicate that glycogen synthesis from lactate within WM in these sharks cannot occur unless an alternative route for pyruvate to phosphoenolpyruvate exists.

31 LATE PREHISTORIC CERAMIC PRODUCTION IN THE UPPER MOJAVE RIVER REGION, SAN BERNADINO COUNTY, CALIFORNIA

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Petrographic analysis of twenty-five ceramic sherds from the Deep Creek and E.S. Young sites, located in the upper Mojave Region of southern California, was undertaken in order to test the assumption that brown wares were locally produced and not intrusive in archaeological assemblages of the late prehistoric period in Southern California. Mineralogical analysis of ceramic thin sections, and samples of clay, sand, and gravel from the catchment areas surrounding the sites, allowed for the distinction of local versus non-local ceramic products. Results indicate that brown ware ceramics recovered from both sites were likely produced in the immediate vicinity of the sites and that these brown wares have unique characteristics which distinguish them from other brown wares found in southern California. No definite location of manufacture of buff wares could be determined, indicating that they may have been imported from another region.

32 ARCHAEOFAUNAL RESEARCH AT LATE HOLOCENE PREHISTORIC SITES ON SAN NICOLAS ISLAND: RECENT EXCAVATIONS AND EXPERIMENTAL STUDIES

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Results of recent archaeofaunal research from two late Holocene prehistoric sites in the Central Plateau of San Nicolas Island are presented. During fall 2004, test excavations were conducted at CA-SNI-44 by a field class from the Department of Anthropology at CSUF. Although earlier archaeologists thought the site had been essentially destroyed by construction activities on the island, our recent excavations indicate that intact prehistoric cultural deposits are present, including well-preserved fish and marine mammal remains. Archaeofaunal investigations at another nearby site on the Central Plateau, that of CA-SNI-102, are also discussed. As a means of explaining the burning patterns observed on fish remains at CA-SNI-102 and other prehistoric sites on San Nicolas Island, an experimental study of fish processing and cooking was conducted, the results of which are presented. Future directions of the archaeofaunal research at these two sites and their implications for understanding overexploitation and resource depression in the late Holocene are discussed.

33 ARCHAEOLOGY AT THE HARVARD HILL SITE, SAN BERNARDINO COUNTY, CALIFORNIA

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McKenna et al., under the direction of the San Manuel Band of Mission Indians, Highland, has been working on the Harvard Hill archaeological site in San Bernardino County. The site is a large, prehistoric occupation area yielding dates of 600 ± 30 years B.P. (ca. A.D. 1400) and representing an extensive scatter of materials indicative of a trade center with multiple occupations. Materials recovered from the site include shell, alphaltum and lithic materials associated with coastal California as well as projectile points, ceramics, and other items indicative of eastern California (the Mojave Desert

and Great Basin), indicating an extensive array of items representing virtually all areas of Southern California. This site, in conjunction with other well documented sites in the area of Barstow and the Mojave River, is evidence that an elaborate trade system existed in the area of the Mojave Desert while other areas of the greater Southwest were experiencing a significant decline in population and exchange.

34 TWO RITUAL CACHES FROM CA-ORA-950: A WINDOW ONTO THE SYMBOLOGY OF COGGED STONES

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Within single cogged stone caches, two cogged stones with identical counts of cogs constitute a "matched pair." Three matched pairs were identified for two cogged stone caches at a Lake Forest, Orange County site. One of these caches also contained an elongate artifact that is probably a fertility/fecundity symbol. The CA-ORA-950 evidence, coupled with that of three caches from two other sites, supports the hypothesis that regional Early Holocene iconography embraced dualistic symbology.

35 PREHISTORIC ADAPTATIONS TO COASTAL WETLANDS: AN 8,000 YEAR VIEW FROM SANTA MONICA BAY, WEST LOS ANGELES

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For over 8,000 years, aboriginal peoples have lived and adapted to the changing environments of the Ballona Lagoon, a drowned river valley located on Santa Monica Bay, West Los Angeles. During this time, the coastal environment, including the Ballona Lagoon itself, has altered significantly with resulting changes in human behavior. This, in addition to a melding of cultural traditions from both the coast and desert, led to a complex social dynamic that flourished in the Los Angeles Basin. Research by Statistical Research, Inc. (SRI) and others at nearly 25 archaeological sites in the Ballona region offers a unique view into human adaptations to coastal wetlands.

36 OPTIMAL RESOURCE PRODUCTION: A MODEL OF CHUMASH IMPACT ON THE ENVIRONMENT IN THE SANTA BARBARA CHANNEL AREA

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The management of natural environments to reach an optimal level of resource production represents a concept that induces archaeologists to generate new interpretations of past cultural depositions. Among these interpretations, prehistoric societies positive/negative impact on the environment along the California Coast present the Chumash as a possible model group for the study of such impacts. The prehistoric long habitation span and high population density of the Chumash along the Santa Barbara Channel coastal area provide evidence in support of a well developed natural resource management program. Using archaeological and ecological applications, this paper presents a possible *optimal resource production* model for an understanding of Chumash relationship with their environment. Within this model, prehistoric Chumash populations appear as colonizers of various microecosystems within their geographic area. These areas, previously disturbed only by natural successions, offered the Chumash a large variety of resources. The *optimal resource production model,* in combination with middle Holocene archaeological evidence, provides a way for studying the maximization of natural resources and their negative/positive impacts on the environment. Attention is given to the climatic changes during the middle Holocene period along the Santa Barbara Channel area and the switch to a more intensified use of land resources. Climatic fluctuations in combination with the use of fire to maximize land resources appear to explain the Chumash impact on the environment within the *optimal resource production model.*

37 "JUNE GLOOM" AND "TULE FOG": CONSIDERATIONS OF THE IMPORTANCE OF CLOUD MOISTURE FOR PREHISPANIC SETTLEMENT AND SUBSISTENCE STRATEGIES IN SOUTHERN CALIFORNIA

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In 1965, Edward P. Lanning published the volume **Peru Before the Incas.** This landmark work clearly established the importance of "lomas agriculture" (the subsistence practices based on vegetative is-

lands formed with coastal fog moisture) as one of the principal features of early human sedentism and the basis for further cultural development on the Pacific coast of Peru. Although similar fog moisture conditions exist on the Pacific coast and in some inland valleys (San Joaquin and Sacramento) of California, their potential importance for affecting prehispanic settlement and subsistence has been generally overlooked. This paper summarizes available climatic and archaeological data from two distinct locations (1) the southern coastal Orange County region, and the (2) more inland San Joaquin and Sacramento Valley regions. On the basis of these preliminary analyses, this paper concludes that the data indicate that, as in Peru, fog moisture played a significant, if geographically limited, role in prehispanic California. Archaeologists conducting research in California are encouraged to integrate theoretical and methodological considerations of fog moisture adaptation with future research and interpretation.

38 PALEOCLIMATE AND VEGETATION RECORD IN THE LATE PLEISTOCENE PALOS VERDES FORMATION ("OLDER ALLUVIUM") IN THE SAN FERNANDO VALLEY, SOUTHERN CALIFORNIA

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Microfossil samples collected from a 50-foot section of Palos Verdes Formation ("Older Alluvium") exposed in excavations near "beautiful downtown Burbank" have produced an unusual Late Pleistocene pollen and spore flora. Surprisingly, the dominant palynomorphs in almost all samples are fern and club moss spores (>40%), followed by pollen of Compositae (~10%), and alders (~5%); all three of these plant groups are common pioneer species colonizing ecologically disturbed areas. This unusual pollen and spore assemblage appears to record ecological disturbance due to glacio-eustatic sea level fluctuations. These fluctuations may have resulted in a rather wide coastal plain with frequent perturbations to the local vegetation. The frequency of disturbances favored opportunistic species that could invade open habitats and reproduce rapidly and prevented the development of ecological climax forests. Samples from a depth of 46–48 feet and from a paleosol at approximately 4–6 feet appear to represent more mature or climax plant communities with greater diversity and more tree species. The palynoflora from these samples include plant species whose modern equivalents live along the coastal summer fog belt in northern California. These modern occurrences suggest that the Late Pleistocene maritime climate that characterized the area was cool, wet, and less seasonal or more equable, in sharp contrast to the strongly seasonal Mediterranean climate with hot, dry summers and warm, wet winters that exists in the region today. Thus, the portion of the Palos Verdes Formation stratigraphic sequence sampled was probably deposited during a glacial-pluvial (cool rainy) stage of the Late Pleistocene.

39 REVISED CORRELATION AND AGE ASSIGNMENTS OF FOSSIL LAND MAMMAL ASSEMBLAGES OF LATE HEMINGFORDIAN TO EARLIEST HEMPHILLIAN (EARLY MIDDLE TO EARLY LATE MIOCENE) AGE IN CALIFORNIA, NEBRASKA, AND TEXAS, BASED ON OCCURRENCES OF TICHOLEPTINE OREODONTS (MAMMALIA, ARTIODACTYLA, OREODONTIDAE, TICHOLEPTINAE) AND OTHER LAND MAMMAL TAXA

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The Green Hills Fauna (F) (low. Resistant Breccia Member [RBM], Barstow Fm. [BF], CA) contains *Brachycrus laticeps,* correlates with the Sheep Creek (type Hemingfordian [He]) and Low. Snake Creek Fs of NE, and is late He, not early Barstovian (Ba). The Second Division F (up. RBM) is latest He. The overlying Low. (type Ba) Barstow F (low. Fossiliferous Tuff Member [FTM], BF) contains endemic *Mediochoerus mohavensis mohavensis* (not *Merychyus medius ?schrammi*) and is early (not late) Ba, while the late Ba, Up. Barstow F (up. FTM) includes the first appearance of the cricetine *Copemys russelli.* The latter three Fs lack definite correlatives in NE. The *Ustatochoerus profectus* (= *M. medius*)/*C. russelli* Assemblage Zone (AZ) (Dove Spring Fm. [DSF] Member 2, CA) contains *M. m. compressidens,* correlates with the Minnechaduza F of NE, and is early Clarendonian (Cl), not late Ba. The latter F overlies the Devil's Gulch F, which contains large *M. m. medius* and correlates with the earliest, type Cl, Low. Clarendon F of TX. The low. *Cupidinimus avawatzensis*/*Paracosoryx furlongi* AZ (DSF Member 3) contains *M. major santacruzensis,* is early late (not early) Cl (pre-Cerrotejonian), and correlates with the Xmas-Kat Local (L)F of NE. The low. (but not basal) *Paronych-*

omys/Borophagus littoralis AZ (DSF Member 6; contains Hemphillian [Hh] index taxon/antilocaprid *Ilingoceros*) and the Kendall-Mallory LF (Orinda Fm., CA) contain *M. ma. ?profectus* and the cricetine *Paronychomys,* correlate with the Snake Creek F of NE (contains *M. ma. ?profectus* and megalonychid sloth), and are earliest Hh (post-Montediablan), not late Cl.

40 CACHE OF FOSSIL REMAINS FOUND IN SAN QUINTIN, BAJA CALIFORNIA LOCATED WITHIN A BEACH CLIFF CAVE

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An ongoing multi-disciplinary cave excavation, located 11 meters above sea level in San Quintin, Baja California, has revealed a variety of faunal remains. The cache includes predominantly carnivorous mammalian species: puma, *Felis concolor,* coyote, *Canis latrans,* grey fox, *Urocyon cinereoargenteus,* sea otter, *Enhydra lutris* and ringtail, *Bassariscus astatus.* Other mammals found in the cave consist of kangaroo rat, *Dipodomys agilis,* and two rabbit taxa: *Sylvilagus sp.*and *Lepus californicus.* In addition, the remains of three species of bird and a whale are represented though yet to be definitively identified. The explanation for the presence of such a diverse collection of faunal remains in one isolated beach cliff cave can be hypothesized by applying a plausible anthropological construct to the data. The indigenous group, Kiliwa, historically established themselves in the San Quintin region approximately 1000 AD. As a seasonal nomadic group, they moved across Baja California's high sierras, San Pedro Martir, and possibly the Gulf of California. Certain animals that were found in the cave were seized and possibly killed in the high sierras, and were then transported to the cave by the Kiliwa people, for ceremonial rituals conducted by Kiliwa shamans.

41 ADSORPTION OF SYNTHETIC PYRETHROIDS ON SEDIMENT

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Adsorption on sediment regulates the fate and bioavailability of contaminants in the aquatic environment. A common way to measure adsorption capacity of organic compounds in soil or sediment is to use the batch equilibration—solvent extraction method in which the solid and aqueous phases are separated by centrifugation and the aqueous phase concentration C_w is determined after exhaustive solvent extraction. However, this method may give artificially depressed K_d for strongly adsorbing compounds such as pyrethroids, as small colloidal particles and dissolved organic matter are not eliminated from the aqueous phase and contribute to the measured C_w. Solid phase microextraction (SPME) selectively detects the freely dissolved concentration and thus may be used to improve K_d measurement. We determined K_d values for eight pyrethroid insecticides using both solvent extraction and SPME to measure C_w. K_d obtained with SPME was 2–100 times greater than that with the solvent extraction method, and the difference was more significant for sediments with higher organic matter content. K_d measured with SPME is expected to be useful for predicting the bioavailability or toxicity of sediment-borne pyrethroids, as it correlates with the free or bioavailable concentration.

42 SURVEY FOR SYNTHETIC PYRETHROIDS WITHIN THE SAN DIEGO/NEWPORT BAY WATERSHED

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The Upper Newport Bay is an ecological reserve located within Orange County, CA. It is a marine estuary that provides habitat for nearly 200 species of birds, and several species of fish, mammals and native plants. The primary freshwater inlet for the estuary is the San Diego Watershed, which is the primary drainage area for the cities of Santa Ana, Tustin, Lake Forest and Irvine. With the increasing encroachment of urban sprawl, there has been a dramatic shift in land use within the San Diego Watershed from agricultural to urban landscapes. There is a concern that this shift in land use will result in an increase of non-source pollution from individual homesteads that use pesticides to aid in ant and weed control. The use of pyrethroids has increased steadily in both agricultural and urban settings as a replacement for organophosphate insecticides. In addition, nursery use has also increased drastically since 1995 as mandated for red and imported fire ant quarantine. Pyrethroids commonly

have high aquatic toxicity, and contamination of surface streams by pyrethroids is of concern. The objective of this study was to determine the presence and spatial variability of pyrethroids within the watershed. Eighteen sediment grab samples were taken from locations within the watershed. Five of the samples were collected at the outlets of existing nurseries. The rest were collected within drainage channels and Upper Newport Bay. Samples were analyzed for pyrethroids using GC-ECD. The frequency, location, and levels of pesticide detections will be presented at the meeting.

43 THE EFFECT OF FEMALE CHEMICAL CUES ON THE AGGRESSIVE BEHAVIOR OF MALE CRICKETS, *ACHETA DOMESTICUS*

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Male crickets, *Acheta domesticus,* show aggressive behavior to gain opportunities for reproduction over other males. Female crickets show a preference towards more aggressive and larger males. Female chemical cues along with residency status should influence male aggression. We hypothesized that aggression would increase with higher levels of female cues and that residents should be more likely to exhibit aggression in the presence of female cues than in their absence. We observed male fights in 14 cm × 26 cm containers with a sand substrate. These containers had previously housed no females, one virgin female, or two virgin females for 48 h prior to the trials. We found no effect of female chemical cues on the amount of aggression. Chemical cues also had no influence on the aggressive behavior of the resident or intruder. We also found that resident status, weight differences, or age differences between residents and intruders did not predict the outcome of the interactions. We did find that the intensity of aggression could be predicted based on the age of resident and intruder males. Older residents and younger intruders were more likely to be aggressive. Our results suggest that residency status and perceived territory quality do not influence aggressive interactions in male house crickets. In addition, these data suggest that age and residency status may be important factors influencing a male's decision to fight. We hypothesize that this pattern is a product of younger intruders having nothing to lose and the cost of territory loss for older residents.

44 THE EFFECTS OF ARTICHOKE THISTLE (*CYNARA CARDUNCULUS*) DENSITY AND COASTAL SAGE SCRUB INFLUENCE ON PREDATION OF ARTIFICIAL NESTS

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Artichoke thistle, *Cynara cardunculus,* is an invasive plant in California grasslands listed on the noxious weed index of the California Department of Food and Agriculture. It may affect native primary producers and consumers, but its invasion impact has not been fully studied. Thistle invasion changes the habitat structure, thus changing the niche composition. Birds may utilize the flower stalk of this exotic plant as a nesting resource. Thistle may impact nest success by providing camouflage from avian predators for birds nesting in grasslands. A comparison of artificial nest survival was made between thistle invaded grassland and grassland with almost no thistle. We hypothesized that higher nest success would occur with nests in thistle invaded grasslands than in grasslands without thistle, and that artificial nest success would be higher with increasing distance away from the surrounding coastal sage scrub habitat. Twenty nests were placed in each type of grassland at 45 m intervals from coastal sage scrub into the transition of grassland. Each nest was baited with one quail egg and two clay eggs. Predation on the nests was checked at 40 and 110 hours. A nest was noted successful if no eggs were disturbed. More nests were successful in grassland invaded with the thistle (60% success) then in grassland without thistle (40% success). Also, nest success rate increased with distance from coastal sage scrub. Comparing artificial nest survival in artichoke thistle invaded grasslands provides a greater understanding of the impacts of artichoke thistle on the habitat it invades.

45 SEWAGE IS AN UNLIKELY SOURCE OF FECAL INDICATOR BACTERIA IN THE LOWER SANTA ANA RIVER WATERSHED

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The Santa Ana River, CA and adjacent wetlands have been identified as potential sources of fecal indicator bacteria (FIB) to the surf zone at Huntington Beach CA. Fecal steroid chemical markers including coprostanol, epicoprostanol, cholesterol, cholestanol, α-cholestanone, β-cholestanone, β-si-

tosterol, stigmasterol, stigmastanol, campesterol, and caffeine were extracted by solid phase extraction (SPE) and supercritical fluid extraction (SFE). The results of these analysis and multivariate statistic were used to examine whether sewage was a significant source of FIB within the Santa Ana River watershed. A difference was found in steroid ratios between river samples, raw and treated sewage from a local treatment plant, or nearby effluent plume. The characteristics of the steroid ratios coupled with the strong correlation between coprostanol and turbidity suggested a diagenetic rather than a biogenic source for the coprostanol in the samples. Additional multivariate statistical analysis showed that the concentrations of FIB were better correlated with bird fecal steroids than with typical sewage steroids.

46 DESCRIPTION OF FIELD-COLLECTED LARVAE OF TWO NATIVE FRESHWATER SOUTHERN CALIFORNIA FISHES, *CATOSTOMUS SANTAANAE* AND *GILA ORCUTTI*

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Larval series of the Santa Ana sucker (*Catostomus santaanae,* Federally Threatened) and arroyo chub (*Gila orcutti,* California Species of Special Concern) are described from specimens collected from the Los Angeles and Santa Ana river drainages. *Catostomus santaanae* larvae are elongate. They have 41–46 myomeres and a distinctive paired-triangle patch of melanophores over the midbrain. Melanophores are present on the snout, dorsal body, lateral line, dorsal gut, post-anal ventral body and caudal fin. Pre-anal length equals 74–79% SL, typical of catostomids. *Gila orcutti* larvae are relatively deep-bodied. They have 36–39 myomeres and a distinctive heart-shaped patch of melanophores over the midbrain with a line of melanophores trailing posteriorly. Heavy pigment is present on the snout, lower jaw, dorsal body, lateral line, gill arches, dorsal gut, post-anal ventral body and caudal fin; they have a shorter pre-anal length of 65–72% SL, typical of cyprinids. These two species often occur together, and less commonly with the local native form of *Rhinichthys osculus* (another cyprinid that is a California Species of Special Concern). Characters distinguishing the three from each other and from other local freshwater fish larvae are discussed along with habitat preferences.

47 AXIAL SPLITTING OF SHRUBS IN WET AND DRY ENVIRONMENTS

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Arid regions around the globe are dominated by shrubs of a unique growth form. They possess segmented woody roots and stems that split apart with maturity, often resulting in complete fragmentation. These species are often dominant in their native habitats and include *Larrea tridentata* and *Ambrosia dumosa* in North America, *Zygophyllum dumosum* and *Artemisia herba-alba* agg. in Israel, as well as numerous *Artemisia* species in the northern hemisphere. Many other species posses strongly fluted or segmented axes, but do not physically split apart. Morphological stem segmentation causes axial segmentation of the hydraulic system. Previous research has shown that woody plants from dry environments show a high degree of hydraulic segmentation of the wood, even if they show no signs of morphological stem segmentation. We postulate that axial hydraulic segmentation introduces redundancy into the hydraulic system, increasing survival of the whole genetic individual, but at the cost of losing parts of the plants to drought-induced mortality. We hypothesized that the degree of hydraulic redundancy in shrubs will decrease along aridity gradients from arid to mesic conditions. To test this hypothesis, we documented the prevalence of morphological axis segmentation in shrubs from a variety of genera along North and South American aridity gradients located between 30° and 35° latitude. Along the same gradients we also measured axial hydraulic segmentation at the anatomical level by mapping pathways of water transport in the xylem using injected dye tracers. The results support our hypothesis that hydraulic redundancy in shrubs decreases from arid to mesic environments.

48 EVALUATION OF METHODS FOR DETERMINING CHRONIC TOXICITY IN MARINE SEDIMENTS

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Sediment quality objectives are being developed in the State of California that are expected to include measurements of acute and chronic sediment toxicity. Acute sediment toxicity methods are commonly used, however chronic testing methods have been used on a much more limited basis in California. This study was designed to compare between several available chronic sediment toxicity protocols and guide the selection of methods for use in California. Sediment samples were collected from bays and estuaries in the Southern California Bight and from San Francisco Bay. Split samples from 15 stations were distributed to four laboratories for testing using six methods: a sediment-water interface method with sea urchin (*Strongylocentrotus purpuratus*) or mussel (*Mytilus galloprovincialis*) embryos; a benthic copepod (*Amphiascus tenuiremus*) life cycle test; a polychaete (*Neanthes arenaceodentata*) survival and growth test; an amphipod (*Leptocheirus plumulosus*) survival, growth and reproduction test, a larval clam (*Mercenaria mercenaria*) survival and growth test; and an oyster (*Crassostrea virginica*) lysosomal destabilization assay. In addition, each station was an also tested using acute methods with two species of amphipod (*Eohaustorius estuarius* and *Leptocheirus plumulosus*). Sediment metals, organics, and grain size were analyzed for each station. There was a wide range of results for the samples with between 8 and 80% of the stations being found to be toxic by any given protocol. Each station was found to be toxic by at least one method and no station was found to be toxic by more than five of the six chronic methods. The *Eohaustorius* acute, copepod reproduction, and polychaete growth endpoints had the strongest correlations with sediment chemistry, but also correlated strongly with sediment physical parameters.

49 LACK OF GENDER-BIASED MICROSITE PATTERNS IN *SALIX LASIOLEPIS*

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Previous studies on dioecious plants have demonstrated differences between male and females in terms of the microsites they inhabit. Reported trends in microsite inhabitation for dioecious plants have been that females inhabit moister habitats than males, seemingly to offset reproduction costs. In this study we looked at the distribution of sexes of *Salix lasiolepis* in a .15 mile reach of the Tujunga River in the San Gabriel Mountains (California) in relation to the thalweg of the streambed. We also focused on the relationship of wood density versus sex in *S. lasiolepis* and as a function of current, as well as xylem to lumen ratio versus sex. Based on previous research, we expect to find that female *S. lasiolepis* inhabiting microsites closest to the thalweg and females would exhibit lower wood densities and therefore greater xylem to lumen ratios than males. However, preliminary results indicate that there are no differences in the distribution of males and females in regards to elevation from the thalweg, wood density of males and females and in xylem to lumen ratios in *Salix lasiolepis.* This could be due to two potential reasons. One is because low summer discharge in the Tujunga River places individuals under water stress, regardless of where they occur in the stream channel, and therefore, rely more on ground water than on surface water. The second explanation is that because freezing places an upper limit on xylem conduit diameter for individuals in the channel, increases in vessel diameter that would lead to lower wood density does not occur.

50a MORPHOLOGY AND MOLECULAR PHYLOGENY OF *EGREGIA MENZIESII*

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The morphology of the feather boa kelp, *Egregia menziesii,* varies considerably throughout its range from Canada to Baja California, México. These traits may be genetically fixed or be indicative of a high degree of plasticity. We characterized the distribution of *Egregia* morphotypes at two sites in Oregon and seven in California. Results show variation in the laterals and rachis corresponding with

latitude, and all populations showed a transition of lateral type with increasing length as has been previously reported. Sequence differences between Oregon and southern California populations are present in the internal transcribed spacer region between the 26s and 5.8s rDNA genes. This genetic investigation provides baseline data for studying plasticity in temperature tolerance, in terms of heat shock protein (Hsp) production, within and among species over large geographic ranges. Hsps are also produced in response to stressors such as hypoxia, metal ion concentration, and organic compounds. This project will lay the groundwork for using Hsps to study tolerances to climate change and anthropogenic stressors in seaweeds. Additionally, physiological comparisons in response to thermal stress between native species and competitive invaders may help determine if thermal microhabitats facilitate invasions. Since high temperature stress has led to the decline of native kelps in southern California, knowledge of the temperature tolerances and physiological responses of native and invasive kelp species can contribute to efforts for conservation and restoration projects.

50b BIOAVAILABILITY OF PERMETHRIN IN SEDIMENTS AND ESTIMATED WITH SOLID PHASE MICROEXTRACTION (SPME)

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The use of synthetic pyrethroid insecticides (SPs) is increasing in agriculture and urban environments. A recent survey showed that SPs were commonly found in aquatic sediments in the Central Valley of California. Therefore, it is imperative to understand the ecotoxicological implications of SPs in the sediment environment. However, because pyrethroids have a high affinity for sediment and dissolved organic matter, their bioavailable concentrations in sediment systems are expected to be significantly lower than the total sediment concentration. Therefore, their sediment toxicity cannot be evaluated based on the whole sediment concentration. In this study, the bioavailability of permethrin to *Chironomus tentans* larvae in water-sediment systems was investigated. During the bioassays, polydimethylsiloxane (PDMS) fibers were used as a "biomimetic" tool to simultaneously measure the freely dissolved concentration of SPs in water-sediment systems. The concurrent analyses facilitated understanding of the relationship between pesticide phase distribution and the biota sediment accumulation factors (BSAF) with different sources of sediment. Generally, larvae accumulated more pesticide in sandy sediment than silt or clay sediments. The amount of chemicals accumulated on the PDMS fiber was well correlated with body residues. This suggests that chemical partitioning into PDMS "mimics" the bio-uptake process and PDMS fiber may serve as a good surrogate for sediment biota.

51 PRELIMINARY ANALYSIS OF A CAVE FAUNA FROM SAN QUINTIN, BAJA MEXICO

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Preliminary identification of fauna from an ongoing multi-disciplinary cave excavation has revealed puma, *Felis concolor,* coyote, *Canis latrans,* grey fox, *Urocyon cinereoargenteus,* sea otter, *Enhydra lutris,* ringtail, *Bassariscus astutus,* the epiphysis of a large whale vertebra and multiple elements of a large aves. Most of these taxa occur in the San Quintin Valley area today though perhaps not in the immediate vicinity of the coast. Exceptions are the sea otter which was extirpated in 1922 (last historical record) and possibly the large bird bones and whale epiphysis which have yet to be definitively identified. The cave is located in a basalt cliff 11 meters above sea level in the vicinity of Bahia de San Quintin approximately 485 kilometers south of San Diego, Ca. on the Pacific coast. It was formed by a lava tube and has the general dimensions of 1.8 meters high, 2.0 meters wide and tapers to a length of 7 meters. The floor sediment consists of quartz- and feldspar-rich aeolian deposited sand. Similar sand covers much of the cliff-top in the form of dunes 10–20 meters in depth. Previous activity by locals had disturbed the sediments, likely revealing bones in the past. The initial assumption was that all sediments had been repeatedly disturbed. However, test excavation begun in November 2004 revealed abundant skeletal material approximately 15–30 centimeters below the present sediment surface.

52 BOLUS REBOUND KINEMATICS DURING ENGULFMENT FEEDING IN THE RORQUAL WHALES

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Rorqual whales (Family: Balaenopteridae) employ unique filter-feeding structures and techniques to controllably engulf massive amounts of prey-laden seawater while feeding. Engulfed water containing a concentration of prey items forms a bolus that enters the whales' distensible ventral pouch through the buccal cavity. The two-dimensional kinematics of this bolus was analyzed using digital video from three species of surface-feeding rorqual whales in the Gulf of St. Lawrence, Canada. Individual still frames were extracted from video sequences and landmarks were placed on consecutive frames to calculate movement, relative to the animal, of the bolus over 1/30 second frame intervals. The bolus initially translated posteriorly inside the ventral pouch then rebounded off the posterior end of the pouch before traveling back toward the buccal cavity. Velocities and directional changes were quantified, and the momentum of the bolus is thought to help initiate the ram filtration process through the baleen plates. Results showed that *Balaenoptera acutorostrata* has the fastest bolus rebound velocity, followed by *B. musculus* and *B. physalus,* respectively. Further work will be performed to help understand the implications of these findings, including how they contribute to scaling relationships between the sizes of the different species and the volumes of the boluses.

53 THE GREATEST GRUNION HUNT IN 50 YEARS: CALIFORNIA GRUNION SIGHTINGS ACROSS THE SEASON AND ALONG THE COAST IN 2004

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California grunion are marine silversides that appear on sandy beaches in the middle of the night for spawning runs. Their populations are difficult to assess because they rarely come up in trawls, they do not take a hook, and they are almost never seen except during their spectacular midnight runs. Recently we developed a method for training citizen scientists to assess grunion runs in widely dispersed areas and to report them instantly to a central database via an internet-based interface. A series of workshops were held in spring of 2004 to train over 350 volunteer Grunion Greeters from four coastal counties. Runs were monitored on 30 specific beaches from San Diego to Monterey Bay over the course of the closed season (April and May), and early June, for a total of 10 nights. Runs were assessed according to the Walker Scale for strength and duration. Runs were highly variable in space and time. We show data for grunion populations across the spawning season and along the coast to examine possible patterns. Although these data are only one year's effort, the number of dates and beaches represented make this the most ambitious assessment of the California grunion spawning population ever attempted.

54 INTERACTIONS OF NEARSHORE FISH ASSEMBLAGES AND NET-PEN MARICULTURE EFFORTS ON SANTA CATALINA ISLAND, CALIFORNIA

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The Department of Fish and Game has developed the Ocean Resource Enhancement Hatchery Program (OREHP) where mariculture of white seabass, *Atractoscion nobilis,* is occurring along the southern California coast. The effects of white seabass shallow water net-pens used in California mariculture are not described in detail. Preliminary analysis has shown that the presence of the artificial canopy created by a floating net-pen used for mariculture in Catalina Harbor, which is next to a kelp bed (*Macrocystis pyrifera*), attracts fishes to it and creates a similar three dimensional community. These net-pens appear to increase localized production due to feed floating into the ambient environment. We have conducted replicate band transects documenting fish size (total length) and abundance. Variation in water column productivity of fishes has been analyzed by comparing fish densities and size-classes that can be used to estimate biomass of the fish assemblage below the net-pen to those metrics occurring at reference sites. This comparison represents a novel case study for the artificial reef attraction-production controversy, as well as describing ecological change in nearby systems caused by mariculture production of fin fish in southern California.

55 A COMPARISON OF PREVALENCE AND MEAN INTENSITY OF THE ECTOPARASITE *ELTHUSA CALIFORNICA* IN SHINER SURFPERCH (*CYMATOGASTER AGGREGATA*) OF TOMALES AND BODEGA BAYS

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The cymothoid ectoparasite *Elthusa californica* is known to parasitize the opercular cavities of the Shiner Surfperch (*Cymatogaster aggregata*). This study examines the numbers and distributions of *E. californica* found on 92 *C. aggregata* from Nick's Cove, Tomales Bay, CA for geographic and temporal comparisons with previous studies. Specimens were collected via a 6 meter impounding seine, packaged individually and then immediately examined for the presence of *E. californica*. No significant differences were found between the populations of *Elthusa calfornica* in Tomales and Bodega Bay. Isopod and host size were significantly correlated. We suggest that the populations found in both bays could be part of the same overall population.

56 ANALYSIS OF HISTORICAL CHLORDANE LEVELS IN SAN DIEGO AND MISSION BAY IN COMPARISON TO THE THRESHOLD LEVEL OF TOXICITY TO THE AMPHIPOD, *EOHAUSTORIUS ESTUARIUS*

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Chlordane was produced as an organochlorine pesticide from 1945 until 1997 when it was removed from the market. Its primary use was as a general insecticide on home lawns and gardens; it was also commonly used as a termiticide. Chlordane has been frequently found in sediments at levels well above published effects-range guidelines near storm drain and creek inputs in both Mission and San Diego Bay. A Toxicity Identification Evaluation (TIE) is underway to evaluate whether chlordane levels near the Tecolote Creek entrance in Mission Bay are at levels that may explain observed toxicity to the marine amphipod *Eohaustorius estuarius*. Chlordane reference toxicant testing will be performed to determine a threshold level for this amphipod species. The data will then be compared to historical chlordane data accumulated over several years from both Mission and San Diego Bay.

57 SEASONAL BACTERIAL CONCENTRATIONS IN THE LONG BEACH/LOS ANGELES HARBOR COMPLEX; YEAR TWO OF A FIVE YEAR STUDY

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Pathogenic organisms coming from non-point sources into coastal recreational waters have been a long-standing public health concern. Freshwater outlets, such as storm drains, are a particularly high source of contamination, especially in the wet season. Bacterial species such as coliforms and enterocci are used to indicate the likelihood of pathogenic organisms in surface waters. Because elevated levels of these bacteria have been linked as a causal agent of stomach flu and other infections, California Assembly Bill (AB411) established maximum allowable concentrations of these bacteria in recreational waters in 1999. The amount of total coliforms, fecal coliforms (as estimated by *E. coli*), and enterococcus were tested mainly in the Long Beach/Los Angeles Harbor complex seasonally and after the first flush (>0.5 inches rainfall). The results show: 1) instead of "seasonal" variation there is a more prominent wet vs. dry pattern, 2) health limits were exceeded after significant rainfall events, and 3) most concentrations abated by the time outlet plumes dissipated throughout the Harbor. Bacterial concentrations correlated negatively with salinity and positively with turbidity, supporting previous studies. The data represent two years of sampling within a 5-year monitoring project, providing data on the dynamics of bacterial concentrations in coastal recreational waters.

58 INDEPENDENT AND JOINT TOXICITY OF PERCHLORATE AND HEXAVALENT CHROMIUM TO LARVAL MOSQUITOES

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Perchlorate and hexavalent chromium are two anthropogenic pollutants found in ground and surface water in areas throughout Southern California, as well as elsewhere in the United States and in the

world. In chronic exposure bioassays in the laboratory, perchlorate and hexavalent chromium were found to decrease survival and prolong development of larval *Culex quinquefasciatus* mosquitoes. The compounds were examined alone and in combination with each other. Perchlorate was found to have an LC50 of approximately 100,000 ug/L, while hexavalent chromium was found to have an LC50 of approximately 900 ug/L. These concentrations are within the range of levels reported from contaminated sites.

59 VARIATION OF JOSHUA TREE MORPHOLOGY AMONG POPULATIONS IN THE EASTERN MOJAVE DESERT

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The current distribution of *Yucca brevifolia* Engelm. (Joshua Tree) is restricted to specific habitats at higher elevations in the Mojave Desert. This distribution warrants investigation because it may represent the result of post-glacial migration and potentially restricted gene flow. The overall objective of our study is to reconstruct the phylogeography of *Y. brevifolia* based on morphological and genetic variances of populations in the Mojave Desert. Some taxonomic treatments of this species define more than one variety based on morphology. This includes *Y. brevifolia* var. *jaegeriana* (McKelvey, 1932), a variety of the Eastern Mojave defined by short, stout stems and short leaf lengths. In a preliminary study we examined the morphology of four populations in this region. The morphological variance of these populations was expected to be minimal, because they occurred relatively close to one another and within the described *jaegeriana* distribution. Trunk sizes and leaf lengths were compared among populations using ANOVA, and a broader evaluation was based on multivariate analyses of 13 tree and leaf traits. Tree sizes and leaf characteristics of three populations always conformed to the classification of var. *jaegeriana*; the fourth population (Garnet Mountain, AZ) showed characteristics of var. *jaegeriana* for leaf traits but not for trunk size. Principle components analysis revealed significant scatter among plants of all populations, but clearly separated the Garnet Mountain population from the rest. These results bring into question the varietal classifications of this species and suggest that environmental factors may cause closely related populations to show notable morphological difference.

60 ENDOCRINE DISRUPTION IN SOUTHERN COASTAL CALIFORNIA FLATFISH

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Some anthropogenic contaminants in the environment interfere with biological processes controlled by hormones, such as sex determination or growth. Previous studies indicate some endocrine disruption (ED) effects occurring in southern California marine fish living near municipal wastewater outfalls in Orange County, the Palos Verdes shelf, and Santa Monica Bay. To determine the extent of these ED effects in the Southern California Bight (SBC), three different flatfish species collected from different locales within the SCB are being studied through our collaborative efforts. This is a multi-year project that aims to develop rapid screening and quantitative assay methods for measuring the incidence of ED effects in marine flatfish. A microarray is being developed to screen the altered regulation of genes associated with endocrine activity. Additional assay methods are being used to validate the microarray results, including a vitellogenin ELISA, gonad histology and several immunoassays for endocrine factors. Our progress is discussed in terms of how this information is leading to a better understanding of the occurrence and magnitude of ED in SCB fish from reference locations and areas proximal to municipal wastewater discharges.

61 HPLC COLUMNS WITH MODIFIED MONOSACCHARIDE DERIVATIVES AS CHIRAL SELECTOR

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To meet the increasing demand for analyzing chiral pollutants, HPLC chiral stationary phases based on monosaccharide were prepared and evaluated. Monosaccharide D-galactose, D-glucose, D-mannose, D-galacturonic acid and D-glucuronic acid derivatives were coupled with aminopropyl or mercaptopropyl functionalized silica gel, and then modified by different groups on hydroxyl groups as

chiral stationary phases. The columns were screened using an identical set of racemic compounds containing a variety of functionalities and the mixture of hexane and isopropanol as the mobile phase. Chiral separation was achieved for some compounds, but baseline separation was obtained only for binaphthol and 5,5′,6,6′,7,7′,8,8′-octahydro-1,1′-bi-2-naphthol. Hydrogen bonding interactions were supposed to result in their chiral separation. It was observed that the chiral resolution ability of monosaccaride derivative CSPs was weaker than that of polysaccharide CSPs. These results suggest that higher level structures of polysaccharide CSPs play an essential role in chiral separation. However, the well-defined monosaccharide HPLC stationary phases could provide valuable insight into chiral recognition mechanism for saccharide-based CSPs, which will be useful for finding and developing more effective CSPs.

62 BIOAVAILABILITY OF SYNTHETIC PYRETHROIDS IN SURFACE WATER

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Synthetic pyrethroids are widely used pesticides in both agricultural and urban environments. Most pyrethroids have high acute toxicity to fish and aquatic invertebrates. On the other hand, pyrethroids are known for their exceptional affinity to solids. In this study, we evaluated the effects of suspended solids in surface water on the bioaccumulation of two pyrethroid insecticides, bifenthrin and permethrin, to aquatic invertebrates. During the bioassays, we simultaneously exposed polydimethylsiloxane (PDMS) fibers as a "biomimetic" surrogate to measure the freely dissolved concentration of SPs in the test system. The concurrent analyses allowed understanding of the relationship between pesticide phase distribution and the measured bioconcentration factors (BCF) in water samples with different levels and sources of suspended solids. In all assays, the BCF consistently decreased with increasing suspended solids, suggesting that association with suspended solids reduced the bioavailability of pyrethroids. For instance, in samples containing 200 mg L^{-1} suspended solids from Miles Creek, uptake of bifenthrin by *Daphnia magna* decreased 65%. Simultaneous PDMS analysis revealed that the dissolved concentration of bifenthrin decreased by 52%. The effect of suspended solids on the bioavailability of pyrethroids was controlled by both the quantity and property of suspended solids. These results suggest that suspended solids in runoff effluents and surface water can decrease the bioavailability of pyrethroids to water-column invertebrates, and this phenomenon should be considered when evaluating the ecological risk and establishing water quality standards for pyrethroids.

63 STRAIN RELATEDNESS OF *CANDIDA* IN HUMANS: A URINARY PATHOGEN OR COLONIZER? (PHASE 1)

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Candida species in the urine of hospitalized patients (candiduria) is a very common occurrence among hospitalized patients with over 50,000 cases complicating hospitalizations annually. However, the clinical significance of candiduria remains controversial as there is evidence that this may represent a potentially serious and deadly infection that may spread to the bloodstream, or, alternately, merely represent urinary tract colonization. To resolve this, samples of urine from over 300 patients from Harbor-UCLA Medical Center were analyzed, and data regarding the patient's fungal infection or colonizations in different body sites, as well as their patterns of uses of antifungal medicines and urinary catheters were recorded. Differences in strains of each Candida infection (strain relatedness) were examined using traditional speciation methods as well as molecular techniques (DNA fingerprinting). The results of this experiment show that *Candida* in the urine commonly resolves spontaneously (97.4% or specimens) and can recur with either the same Candida strain (76.3%), or a different strain (23.7%). Furthermore, patients with Candiduria and Candidemia were more likely to lack strain relatedness (88.9%) than have strain relatedness (11.1%). Finally, antifungals did not have any effect on the persistence (3 days with versus 2.446 without treatments) nor the recurrence (2.67 recurrences with versus 2.53 without treatment) of fungal infections. Consequently, *Candida* in the urine among hospitalized patients does not appear to be associated with serious *Candida* bloodstream infections. Candiduria infectants tend to wax and wane with time, and occasionally are supplanted with other *Candida* strains. This suggests that most *Candida* strains have low pathogenicity in hospitalized patients and may not require treatment.

64 EFFECTS OF PHOSPHATE ON THE BIOLOGICAL PROCESSES OF TRICHODESMIUM

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The marine cyanobacterium *Trichodesmium* occurs throughout the tropical and subtropical oceans. These bacteria are unusual in their ability to convert atmospheric nitrogen into ammonium while undergoing photosynthesis and are responsible for the majority of the nitrogen supply in the open oceans. In exploiting their ability to fix nitrogen, the use of the oceans as a carbon dioxide sink can be maximized, helping to alleviate global warming. This research focused on the role of phosphate in the biological processes of *Trichodesmium* and its effect as a limiting nutrient. It is postulated that *Trichodesmium* has the ability to hydrolyze inorganic molecules to obtain an additional source of phosphorous, known as alkaline phosphatase activity (APA). This experiment tests *Trichodesmium*'s APA response in a variety of phosphate concentrations with an inorganic molecule, 4-methylumbelliferyl phosphate (MUF-P). An inverse relationship between the phosphate concentrations and the amount of MUF-P hydrolyzed was found, confirming the theory that the cyanobacterium has the ability to provide itself with additional phosphorous, should the need arise. The experiment also analyzed the relationship between the concentration of phosphate available and the nitrogen fixing ability of *Trichodesmium*. Using the acetylene reduction process, a direct relationship between the two components was found, verifying the role of phosphate as a limiting nutrient. A better understanding of the role that phosphate plays in maintaining a elemental balance in the open oceans is essential in implementing the use of the oceans as a biological sink for carbon dioxide, thus lessening the major threat that global warming currently presents.

65 DETERMINATION OF BACTERIAL AND POLLUTANT FLOWS IN COASTAL ESTUARIES OF SOUTHERN CALIFORNIA

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There are two main objectives of this experiment: to create a mathematical model showing the relationship between turbidity, dissolved oxygen, pH, salinity, time from high tide, and levels of indicator bacteria for fecal contamination and to assess the impact of the Ballona Wetlands on coastal ocean waters. In the field samples were tested for temperature, dissolved oxygen, salinity, and pH levels using the YSI 600R Sonde Electronic Probe. Further testing was done in the lab using the HACH 2100N Turbidimeter for turbidity levels and IDEXX Quantitray 2000 System with the MPN method for levels of indicator bacteria. A mathematical model was created showing the relationship between dissolved oxygen (DO), turbidity (T), pH, salinity, time from high tide, and bacterial growth (EB), where K is the constant of proportionality, and d, a, and b are constants.

$$EB = K\frac{e^{|(-|7\ -\ pH|)+DO+Sal|}[\cos(2\pi t/\beta) + d]}{1 + ae^{(-bT)}}$$

E. Coli: $K = 1.09 \times 10^{34}$; $d = 85.0$; $a = 7.10$; $b = 4.77$

Enterococci: $K = 1.90 \times 10^{-1}$; $d = 30.0$; $a = 2.49$; $b = 4.77$

Results indicated that bacterial levels were higher with decreased dissolved oxygen, decreased salinity, and increased turbidity in a neutral pH. Bacterial levels were also higher at and around high tide. This study shows that sophisticated mathematical models can be constructed to greatly simplify the current testing procedures and be more cost-effective. This model will prove critical from an economic point of view and from beach safety considerations.

66 NEAR REAL-TIME DETECTION OF *ESCHERICHIA COLI* FOR MONITORING BEACH WATER QUALITY

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Currently used methods for detecting fecal indicator bacteria in recreational water require 18–24 hours for sample analysis. Because this poses obvious problems for safeguarding public health, real-time methods for FIB and pathogen detection in environmental waters need to be developed and

tested. We are adapting for use in marine waters a recently developed method for near real-time *E. coli* detection based on immunomagnetic separation and quantification of ATP using luciferin/luciferase. We have documented levels of ATP (in RLU units) per cell in a lab culture of *E. coli* during the lag, exponential, and plateau phases of the growth curve. Good calibration curves were attained at each growth phase; however, the level of ATP per cell in the *E. coli* population was observed to be a function of its growth phase. We are comparing the near real-time method with membrane filtration and IDEXX, a standard technique currently used extensively in Southern California for monitoring recreational water quality.

67 INDIVIDUAL AND JOINT EFFECTS OF SELENATE AND METHYLMERCURY ON A TERRESTRIAL INSECT DETRITIVORE

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Although insects play crucial roles in most ecosystems, surprisingly little is known about how anthropogenic pollutants or their mixtures affect insect populations. In this study we investigated the individual and combined effects of selenate and methylmercury on the larval stage of a ubiquitous insect detritivore *Megaselia scalaris*. We found that females did not avoid depositing eggs on food sources contaminated with either selenate or methylmercury. However, larval survival was significantly decreased and larval development was significantly prolonged by selenate and methylmercury individually at low or intermediate treatment levels that are ecologically relevant. In addition, potentiation was strongly evident as mixtures containing concentrations as low as only 1% of the respective individual LC_{50}s caused significantly more mortality and delayed larval development than would be expected from the responses selenate and methylmercury elicit individually. Indeed, the relative toxicity to *M. scalaris* of each of the individual and joint treatments was selenate (LC_{50} = 260 μg/g) < methylmercury (LC_{50} = 22 μg/g) < mixture (LC_{50} = 13 μg/g of selenate plus 1.1 μg/g of methylmercury). The increased mortality and delayed larval development within sites contaminated by selenate, methylmercury, or the combination, have substantial implications for the ecology, population dynamics, and sustainability of *M. scalaris* populations. If these results can be extrapolated to other arthropod detritivores, ecosystem food-web function may be substantially affected.

68 HEAVY METALS IN THE CLAM *MEGAPITARIA SQUALIDA* FROM APPARENTLY POLLUTION-FREE ZONES IN BAJA CALIFORNIA, MEXICO: CONSIDERATIONS FOR HUMAN HEALTH EFFECTS

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Bahía de La Paz, a bay within the Gulf of California, has been traditionally characterized as free of industrial sources of pollution and having a population density low enough to avoid serious problems. The "chocolate clam" *Megapitaria squalida,* is widely consumed by the population of several localities along the Pacific coast. Clams collected from seven stations located in Bahía de la Paz, before and after the summer rainy season were analyzed for Cd, Ni, Cu, Mn, Pb, Fe, and Zn. The location of the sampling sites significantly affected the concentration of metals in clam tissues, but not in relation to the proximity to alleged contaminated sites. Clams from a site close to a phosphate mine had the highest levels of Pb, but only in April, and the highest concentrations of cadmium were recorded in clams collected in areas without any anthropogenic activities. Clams from a sites considered clean had higher levels of Cd, Fe, Zn, and Mn. The mean concentrations (μg/g dry weight) ranged from 1.5 to 11.1 for Cd, 1.9 to 8.8 for Ni, 5.4 to 18.7 for Cu, 2.5 to 9.3 for Mn, 0.06 to 7.8 for Pb, 154 to 558 for Fe, and 47.2 to 64.6 for Zn. Based on the results obtained in this study, the consumption a regular meal of 200 g of clam tissue does not represent a risk for human health and proportion a good source of essential elements.

69 SUSCEPTIBILITY OF OXIDATIVELY CROSSLINKED β-AMYLOID PEPTIDES TO INSULIN DEGRADING ENZYME

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Amyloid-Beta protein (AB) plays an important role in the pathogenesis of Alzheimer's disease and is thought to be the cause of neuronal deaths. Oxidized AB and oxidatively crosslinked were examined to see if they were less susceptible to protease digestion by insulin-degrading enzyme (IDE), a major

AB degrading enzyme and compared digestion by the more general protease, trypsin. AB40 and AB42 peptides were each oxidized with either NBS or CU/H2O2. Oxidized AB40 and AB42 lyophilized and resuspended and then desalted using C18 spin columns. They were then assayed using BCA protein method to determine the recovery of AB from the columns. Non-oxidized and oxidized AB40 and AB42 were subjected to proteolysis with IDE or trypsin and then were electrophoresed and analyzed by Western blot. Results have shown that trypsin is able to degrade unoxidized AB40 and AB42 but is unable to digest oxidized samples of AB. IDE was only able to digest partial amounts of unoxidized and oxidized AB. This is a deviation from previous research which has shown that IDE is able to fully degrade unoxidized AB. Further research may be continued to determine whether there may be inhibitions in IDE's abilities to degrade AB due to oxidation.

71 THE HISTORY OF WILDLAND FIRES IN AMERICA

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Fire was a common tool used by pioneers, loggers, farmers, and ranchers prior to 1900. Natural ignitions burned uncontrollably. Promiscuous and careless uses of fire lead to restrictions shortly after 1900. The Smokey-the-Bear anti-fire campaign and propaganda was so effective that by 1940 burning in America was virtually shut down. Burning persisted in only a few local areas, labeled "backward" by the Government. Starting in 1960, ecological studies began to document the natural role of fire in various wildlands and to question U.S. policies of putting out all fires and labeling all fires as bad. By 1980 controlled burning was becoming commonplace and plans were being made to let some lightning ignitions burn. Most federal and state agencies dealing with natural resources had developed prescribed burning guidelines. The movement to restore the natural role of fire suffered a setback with the massive 1988 Yellowstone wildfire. Questions of liability, inability of burners to obtain insurance, and lack of confidence and skill, and concerns about costs, budgets, limited burning opportunities, and other bureaucratic red tape began to delay burning. As a result, the restoration of fire to appropriate ecosystems in their natural sequence continues to be inadequate. This is particularly true in southern California where chaparral occurs on steep terrain and is juxtaposed on urban development. Meanwhile, the payback of a century of fire exclusion continues with one record-breaking wildfire after another, year after year!

72 ECONOMIC IMPACT OF WILDLAND FIRES

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A recent international symposium on fire economics held in Córdoba, Spain highlighted many of the common concerns with the problems of wildland fires throughout the world. Some of the most prominent reasons presented for the continuous and increasing wildland fire problem were related to social and economic factors such as poverty in rural areas, particularly in developing countries economies, and land abandonment of the rural areas in Europe. A related problem, and possibly the most prominent here in California, is the population increase and higher concentrations along forested areas, creating the new coined problem of the wildland urban interface (WUI).

It was evident from regional presentations at the symposium that the costs associated with the wildland fires problem and fire management programs are substantial ranging in the billion of dollars. For example, since 2000, the United States Department of Agriculture Forest Service (USDAFS) alone has spent more than $1 billion annually in forest fires suppression. Canada spends and average of $400 to $800 million annually. Neither of these figures includes timber, health, recreation or personal property related expenditures. In the South American continent losses are estimated as high as $1.6 billion annually. Recent estimates of the impacts of the Indonesian fires of 1997 on the economies of Indonesia, Malaysia, and Singapore were as high as $4.5 billion. Closer to home, in 2003, in California alone, 750,043 acres were burned, 3,710 homes destroyed, 24 lives lost, and more than $3.5 billion in property losses!

73 POST-FIRE EROSION IN THE SAN GABRIEL MOUNTAINS

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Wildfire is a significant disturbance event that promotes accelerated erosion in upland watersheds. This accelerated erosion can cause environmental site degradation and may threaten life, property, and infrastructure in human communities downstream at the wildland/urban interface. Management treatments following a wildfire in 1960 involved the vegetation type-conversion of some native chaparral watersheds to a mixture of perennial grasses on the San Dimas Experimental Forest (SDEF) in the San Gabriel Mountains. In September 2002 virtually the entire SDEF burned again in the Williams Fire, including several small (2–3 ha) headwater catchments in both brush and grass fuel types. Hillslope erosion was measured in 30 cm aperture sediment collector traps. Pre-fire erosion was 10 times greater under native chaparral than on grass hillsides. Compared to pre-fire erosion, first year post-fire hillslope erosion was ten times greater under brush vegetation and over 100 times greater under grass. Prescribed fire produced less erosion than wildfire on comparable chaparral hillsides. Small watershed sediment yield was measured in reservoirs behind debris dams. Prior to burning, sediment yield in both grass and chaparral watersheds was small, and varied with annual rainfall. After the wildfire, large amounts of sediment were delivered to the reservoirs under moderate rainfall, regardless of vegetation type. Prescribed fire produced less sediment yield than wildfire in comparable chaparral watersheds. Although accelerated erosion and sediment yield after burning appears to be inevitable, prescribed fire may be an effective sediment management tool.

74 NEW TRICKS ON THE OLD FIRE

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The Old Fire will not soon be forgotten by Southern California firefighting agencies. In October 2003, it burned over 90,000 acres, 940 homes, and 30 commercial structures. It resulted in six fatalities, and contributed to a deadly flash flood in Waterman Canyon two months after the fire. The Old Fire also was the first time that an integrated weather/fire behavior modeling system was used to predict the fire's growth on a daily basis. This presentation describes the weather modeling (MM5), fire behavior modeling (FARSITE), and fire imaging (FireMapper™) technologies that provide a powerful array of tools for wildland fire science and management.

75 STRATEGIC FIRE MAPPING–TECHNOLOGY DEVELOPMENT FOR AIRBORNE REMOTE SENSING OF WILDLAND FIRES

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A new airborne thermal-imaging radiometer, the FireMapper®, has been developed by the Pacific Southwest Research Station (PSW) and Space Instruments, Inc, for strategic fire mapping and to improve fire suppression operations, fire-fighter safety, and our understanding of the behavior and environmental impacts of wildland fire. Based on night-vision technology developed by the U.S. Department of Defense, FireMapper measures thermal radiation from spot fires and intense flaming fronts alike; resulting estimates of ground-surface temperatures provide a measure of the intensity and progress of wildland fires. The FireMapper was deployed during the fire emergency in California during 2003 aboard PSW's Airborne Sciences Aircraft, N70Z, a twin-engine Piper Navajo. Data were uplinked by satellite communication, geo-referenced to a map base, and posted to the Internet at *www.fireimaging.com* for use by fire operations. Best delivery time to the Internet was 90 minutes. The PSW system has now been improved with an advanced inertial navigation system and satellite communications with a goal of delivering data to the Internet in less than one-half hour. Next-generation FireMapper 2.0 instruments have also been engineered and put into use aboard N70Z and N30W, an Aerial Supervision Module operated by the Bureau of Land Management.

76 CHANGES IN SPATIAL DISTRIBUTION AND ABUNDANCE OF BIRDS IN RELATION TO FIRE AND DROUGHT-INDUCED VEGETATION MORTALITY IN SOUTHERN CALIFORNIA

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Avian community changes were studied in relation to fire history and a severe drought in a Mediterranean ecosystem in the San Jacinto Mountains in southern California for five years pre-drought (1997–2001) and a planned five years post-drought (2004–2008). Plots were established in mixed oak, mixed conifer, and mixed chaparral vegetation types. Bird surveys were conducted on 87 variable circular plots during migration and breeding periods (March–June) using trained observers for five minutes between 0600 and 1030. Vegetation was measured at two sites on each bird plot. Habitat data included tree age (based on cores and fire history), height, dbh, canopy cover, shrub cover, and herbaceous cover. We used a geographic information system (GIS) and logistic regression to predict and map the pre-drought spatial distribution of birds. Resident granivorous and insectivorous birds were most likely associated with old growth (> 50 years since last burn) chaparral stands. Migratory insectivorous birds were associated with mixed oak woodlands adjacent to water and patches of mixed conifers. First year results of the post-drought data indicate increases in relative densities of resident birds in plots with high drought-induced tree mortality and no changes in relative densities of migratory birds in those plots. These preliminary analyses suggest that fire and drought related vegetation mortality are not necessarily detrimental to avian communities and have mixed effects on these communities.

77 THE CONTRIBUTION OF FOREST INSECTS AND PATHOGENS TO TREE MORTALITY IN SOUTHERN CALIFORNIA MONTANE FORESTS

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A severe multi-year drought in southern California caused extensive vegetation mortality which peaked in 2003. That September aerial surveyors mapped woody vegetation mortality above 1% (background) on 522,000 acres of a total of 819,000 acres on the San Bernardino National Forest. Woody vegetation mortality of above 10% was observed on 450,000 acres. In some areas pine mortality approached 100%. The Peninsular Ranges of San Diego Co. experienced similar levels of mortality, while less mortality occurred in the Transverse Ranges west of the Cajon Pass. Pine forests were especially affected because of an outbreak of native bark beetles, in particular, *Dendroctonus brevicomis, D. ponderosae,* and *D. jeffreyi.* These bark beetles kill pines that might otherwise survive drought. Air pollution injury and plant diseases, especially *Heterobasidion annosum* and *Arceuthobium* spp., contributed to tree stress, facilitating successful colonization by bark beetles. Less aggressive insect pests, particularly *Ips* spp., *Scolytus ventralis,* and *Melanophila californica,* killed trees not colonized by more aggressive insects. In 2004 pine mortality and the population of *D. brevicomis* declined for unknown reasons. Bark beetle populations are expected to drop further because of above average precipitation this winter. Public and private landowners responded to the mortality by removing dead trees to reduce hazardous fuels around communities. Long term effects of the mortality are unknown, but include lengthy recovery times for some ecosystems (e.g., single leaf pinyon in the Santa Rosa Mountains), probable increase in *H. annosum* infection centers, and possible species and genetic shifts associated with forest regeneration and replanting.

78 WILDFIRE AFFECTS SOUTHERN CALIFORNIA RIPARIAN HABITAT

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In June 2002, two wildfires (Louisiana and Blue Cut) burned over 13,000 acres, including important riparian habitat along Cajon Creek near Cajon Pass, San Bernardino County, CA. Cajon Pass is a heavily used corridor with freeways, trains, and utilities that run alongside and bridge Cajon Creek. This and adjoining perennial drainages are used for recreating and are channeled for flood control. Natural processes are thus disrupted, and the distribution and range of many species is constrained. Sections of Cajon Creek were denoted suitable habitat for three federally listed species—arroyo toad (*Bufo californicus*), least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empi-*

donax traillii extimus); and one forest sensitive species—Santa Ana speckled dace (*Rhinichthys osculus*). After the fires, all burned trees near the railroad bridges that crossed Cajon Creek were cut. We initiated a study to determine how fire and tree removal affected the riparian habitat for the native species. We sub-sampled vegetation with line transects running across the creek in unburned, burned, and burned and cut areas. Tree removal reduced recovery rate of burned area vegetation for both height and percent cover. Burned area shrubs and herbaceous plants benefited from the reduced overstory. Rapid recovery of suitable habitat for fauna was observed, but vertical dimensions were still below pre-burn measures 2 years later. Post-fire bird surveys revealed continued use of the riparian area, and Santa Ana speckled dace were observed in Cajon Creek. Many species using this riparian area demonstrate remarkable resilience to fire and post-fire disturbances.

79 SAN DIEGO FIRE RECOVERY NETWORK: WORKING AND LEARNING TOGETHER

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The October 2003 wildfires were unprecedented for San Diego—with 16 deaths, 2600 homes lost, and 390,000 acres blackened. We were awed by the power of wildfire, by the personal and community losses, by nature's resilience and recovery, and by the reality that we are "between fires" in these Mediterranean and semi-arid ecosystems. Less than a week after the October 2003 wildfires began, the San Diego Fire Recovery Network was formed, holding meetings at the San Diego Natural History Museum. This open network has representation from more than 100 scientific and community organizations, and public agencies working together to foster the recovery of our human and natural environment through sound science, public education, land and community restoration. More than 400 professionals have attended one or more of the workshops and meetings on fire ecology of chaparral; fire ecology of San Diego's forests; "firesafe" construction and "firewise" landscaping; and post-fire watershed recovery. Professionals, volunteers and students worked together on wildlife surveys through the San Diego Mammal Atlas and Bird Atlas, wildfire education videos, the *Earth, Wind & WILDFIRE* exhibition at the San Diego Natural History, community fire plans, and more. In cooperation with the US Forest Service Riverside Fire Lab, four interdisciplinary workshops will be held in June 2005 across southern California to help define the socioeconomic and political gaps in reducing wildfire risks in chaparral ecosystems while sustaining native habitats, biodiversity, and watersheds as wildland-urban interface and exurban development accelerate.

80 HOW ISLAND SCRUB-JAYS ATTAIN BREEDING STATUS IN LIMITED HABITAT

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The Island Scrub-Jay, *Aphelocoma insularis,* is an endemic resident of Santa Cruz Island. Earlier studies have shown these birds to be permanently territorial and monogamous. Young birds generally take three or four years to obtain a territory. The most common method is for a pre-breeder to replace a member of an established pair upon the death of an adult of either sex. Other documented methods include usurping a territory upon the death of one breeder, amalgamation of adjacent territories and divorce and re-pairing of older breeders. Whatever the method utilized, obtaining a territory or becoming part of a territorial pair is prerequisite to becoming part of the breeding population

81 POPULATION GENETICS OF PYGMY NUTHATCHES IN SOUTHERN CALIFORNIA

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We sequenced 1639 base pairs of mitochondrial DNA to examine the distribution of genetic variation among pygmy nuthatch (*Sitta pygmaea*) populations in southern California. Pygmy nuthatches are small songbirds resident in coniferous forest throughout western North America; they occur in the mountains of southern California as disjunct sky island populations. In order to determine the extent of gene flow among these disjunct populations, we used portions of cytochrome *b,* ND6, and the control region to characterize the genetic differentiation within and among mountain ranges, as well as between the 2 subspecies (*S. p. melanotis* and *S. p. leuconucha*) that occur within the study area. Analysis of 75 individuals from 11 collecting locations in 7 mountain ranges yielded 17 haplotypes.

Measures of genetic distance were low among both haplotypes and populations (mountain ranges). Phylogenetic analyses showed strong support for several haplotype clades. These clades, however, appear only weakly correlated with geography. The overall F_{ST} for mountain range comparisons was relatively low but significant, indicating the presence of some genetic structure. Additionally, a Mantel test based on collecting locations revealed a significant isolation by distance effect. Results from AMOVA suggest weak but significant genetic differentiation between *S. p. melanotis* and *S. p. leuconucha,* with the restriction of gene flow occurring between the Transverse and Peninsular Ranges. Overall, these results indicate that gene flow is restricted among southern California pygmy nuthatch populations, but that these populations are recently diverged.

82 SEASONAL AND INTERANNUAL MOVEMENTS OF SALTON SEA- HATCHED BLACK SKIMMERS (*RYNCHOPS NIGER*)

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Over 2570 pre-fledging Black Skimmers (*Rynchops niger*) have been banded at the Salton Sea in southeastern California between 1991 to 2004; nearly all of these were given additional alphanumeric or color bands to identify individuals or cohorts. Our re-sighting efforts in coastal California and western Mexico during the non-breeding season have yielded important information on migratory movements and suggest considerable interconnectivity of breeding populations throughout the region. Of the 937 skimmers banded at the Sea in the years 1999 to 2001, 275 birds have been re-sighted at least once. Of 62 of these birds re-sighted during the first winter after fledging, 37 (60%) were along the Pacific Coast of California or northwestern Baja California and 25 (40%) were in the Gulf of California or the mainland west coast of Mexico. Analysis of the remaining re-sighting data shows a complex set of outcomes, with some birds that disperse to the Pacific Coast remaining there to breed, but others returning to breed at colonies at the Salton Sea or Colorado River delta region. Most birds dispersing to the Gulf and western Mexico remain to breed in the Salton Sea/Gulf region (south at least to southern Sonora), but some have appeared at coastal California colonies. Furthermore, some birds banded as pre-fledglings in coastal California colonies have wintered on the west coast of mainland Mexico and in a few cases have subsequently been re-sighted at Salton Sea breeding colonies.

83 OVER-WINTERING BEHAVIOR OF BLACK SKIMMERS IN SOUTHERN CALIFORNIA: SITTERS AND WANDERERS

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The Black Skimmer is a recent, but now well established, breeding species in southern California. A large portion of the coastal population, augmented by birds from the Salton Sea colonies, now overwinters at 3–4 local sites. Although these sites are regularly used by skimmers year after year, site fidelity of individual birds is highly variable. Some individuals have been regularly, if not always, found at only one site winter after winter. Others move between sites, even one or more times within a single winter season. The causes for these contrasting behaviors are not readily apparent although adverse weather conditions may play a role in some cases.

84 AVIAN EXTIRPATION AND COLONIZATION IN THE BALLONA VALLEY, LOS ANGELES COUNTY, CALIFORNIA

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Successful ecological restoration depends on a clear understanding of the history of local species loss and colonization. One area of California where this can be uniquely achieved is the Ballona Wetlands, one of the best-studied coastal habitats in the state, recently acquired for restoration and protection as a proposed Ecological Reserve. Though birds are among the primary beneficiaries of this effort, the avifauna of Ballona has not been critically examined in more than 60 years. Drawing from historical and current records, I identify 40 taxa that have been extirpated from the wetlands in

one or more role since 1900. Of these, 11 have subsequently become reestablished as regular nesters or winterers after an absence of several decades, and 19, including four non-native taxa, have apparently colonized in one or more roles since the mid-1900s. I analyze this turnover in terms of three major periods of local habitat change, including stream-channelization; wetland draining and creation; agricultural expansion and decline; urban expansion; the construction of a massive marina; and the spread of non-native plant and animal species. This research should facilitate the development of target species to be monitored as the system is restored

85 CHANGES IN BIRD SPECIES DIVERSITY FOLLOWING A SALTMARSH RESTORATION PROJECT AT BATIQUITOS LAGOON

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Batiquitos Lagoon is located in the City of Carlsbad, north San Diego County. Once a tidal system, it was largely non-tidal for 90 years, prior to a $60 million lagoon restoration project conducted from 1994 through 1996 as a mitigation project by the Port of Los Angeles. Following restoration, a long-term biological monitoring program was initiated. It included surveys for vegetation, fish, benthic infauna and birds in years 1, 2, 3, 5, and 10 following lagoon restoration. Avian surveys were performed quarterly during those years to document the changes in bird usage following construction. During 1998 and 1999, mudflat habitat supported the highest densities of birds during all quarters. This was a change from 1997, when shallow water and open water supported substantially higher densities of birds, and was due to development of mudflats within the lagoon following construction. Other changes in bird habitats, species diversity, overall bird numbers, bird guilds, and populations of special-status species at the lagoon observed during surveys conducted in 1997, 1998, 1999 and 2001 will be discussed.

86 SPECIAL STATUS BIRDS OF THE WHITTIER NARROWS BASIN, LOS ANGELES COUNTY

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The 1500 acre Whittier Narrows Recreation Area and adjacent San Gabriel River and Rio Hondo Rivers in South El Monte supports a remarkable diversity of bird species. A total of 293 bird species (298 species and subspecies) has been recorded in the area through April 2005. Particularly important to birds is the presence of year-round surface water in the form of ponds, lakes and streams and the associated riparian vegetation. Analysis of over forty years of records resulted in the publication of the first comprehensive, annotated work on bird species occurrence and seasonal use of the area (currently under revision). The area supports over fifty Special Status bird species (some seventy species from the State Special Animals List have occurred) such as Least Bittern and Least Bell's Vireo, and these are highlighted as to seasonal distribution and breeding status. Recent changes in the status of several species, such as establishment of heron and cormorant rookeries and nesting yellow warblers, and current land use conflicts and management difficulties are briefly discussed.

87 POPULATION STATUS OF ROYAL TERNS IN SOUTHERN CALIFORNIA

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The Royal Tern, *Sterna maxima*, is an abundant seasonal breeder on the Atlantic and Gulf coasts. On the Pacific coast, however, it is decidedly less common, with perhaps fewer than 100 pairs currently breeding in California. This is very different from the situation 50 years ago when it was one of the commonest large terns in this area. Its decline and recovery (?) seems related to a similar decline (and recovery?) of a favorite inshore prey item, the Pacific Sardine, *Sarninops sayax*. Adult annual survival is high (>88%), as is true of other tern species, and the local breeding population seems to be increasing, albeit slowly.

88 POPULATION STATUS OF THE CALIFORNIA LEAST TERN

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The California least tern (*Sterna antillarum browni*) breeds from April through August at nesting areas along the coast from the San Francisco Bay, California to lower Baja California, Mexico. Prior to its listing as endangered under both the federal and California Endangered Species Act in the early 1970's, the progressive conversion of suitable nesting habitat to human uses had resulted in a severe reduction in both nesting sites and numbers of nesting pairs. Thereafter, the number of nesting pairs in California escalated from an estimated 664 in 1976 to over 6,000 in 2004, and up to 38 nesting sites are now used, up from 23 in 1976, when statewide censuses were initiated. However, over 80% of the nesting population is concentrated in 10 sites. In addition, poor production years such as 1999 still threaten the population, as does predation by a variety of both native and non-native predators. Thus, continued management will be required to ensure long-term survival. Population and productivity fluctuations, existing management and monitoring methods and recommendations for future monitoring and management will be discussed.

89 LEAST BELL'S VIREO IN THE SANTA ANA RIVER WATERSHED

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At one time considered common, the least Bell's vireo *Vireo bellii pusillus* was widely distributed throughout the Central Valley and other low elevation riverine systems of southern California and Baja California, Mexico. However, by the mid-1900s habitat loss due to agricultural, urban, and commercial developments, flood control and river channelization projects, livestock grazing, and other activities had severely reduced the available habitat and the vireo was extirpated from much of its former range. Nest parasitism by brown-headed cowbirds *Molothrus ater* greatly limited the vireos' reproductive output and in concert with habitat loss, vireo numbers plummeted. When the vireo was finally listed as endangered in 1980, there were only 300 pairs known to exist throughout the historic range.

Orange County Water Districts' vireo management program began in 1986 when 21 territories and 19 pairs were documented. Nineteen nesting seasons later in 2004 there were 590 vireo territories found in the Prado Basin. The efforts in the basin have been mirrored outside the basin throughout the watershed since 2000 by the District and its partners in the Santa Ana Watershed Association (SAWA) and an additional 249 vireo territories were observed on the river and tributaries in 2004. Thus, the Santa Ana River held a minimum total of 837 territories in 2004 compared to 824 territories on Camp Pendleton.

The expansion of the vireo population on the Santa Ana River was achieved by dedicated field staff adaptively managing natural resources. The significance of this achievement is that it happened on a river system that has been greatly altered by human activity and has been dramatically narrowed and heavily urbanized to its very edges. It demonstrates that consistent wildlife management works for some species.

90 POPULATION STATUS OF THE WESTERN GULL-BILLED TERN (*STERNA NILOTICA VANROSSEMI*) IN NORTH AMERICA

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The Western Gull-billed Tern is a highly localized breeder, nesting at just a handful of locations in California and western Mexico. In California, the tern forms small nesting colonies at only two locations, the Salton Sea and south San Diego Bay. Gull-billed Terns colonized the Salton Sea by the late 1920s, but the colony in San Diego Bay was not established until 1986. Until recently, a lack of information on breeding locations in western Mexico has hampered efforts to estimate the total population size for this subspecies; the only known colonies were in the Colorado River delta region (Cerro Prieto and Isla Montague) and Bahia Santa Maria, Sinaloa. Surveys in Mexico in 2003 by Palacios and Mellink documented the existence of four previously unknown breeding locations, one in Baja California Sur, two in Nayarit and one in Colima, bringing the number of colony sites in Mexico to seven. Colony sizes are generally small but ranged from 2 to 200 pairs. Results of simul-

taneous surveys in California and western Mexico in 2003 suggest that the entire breeding population of the Western Gull-billed Tern consists of fewer than 600 pairs. The expected degradation of habitats at the Salton Sea as a result of reduced freshwater inflows and proposed urban development, and conflicts with listed species in San Diego threaten the viability of this species in California.

91 POPULATION STATUS OF LIGHT-FOOTED CLAPPER RAIL

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The Light-footed Clapper Rail (*Rallus longirostris levipes*) is a State and Federally listed endangered species that is resident in coastal wetlands in southern California and northern Baja, California, Mexico. Loss and degradation of habitat threaten the continued existence of this bird, although management efforts now offer some promise of recovery.

The twenty-fifth annual census of the Light-footed Clapper Rail in California was conducted from 23 February–23 May 2004. Thirty coastal wetlands were surveyed by assessing call counts from Carpinteria Marsh in Santa Barbara County, south to Tijuana Marsh National Wildlife Refuge (NWR) on the Mexican border.

A total of 350 pairs of Light-footed Clapper Rails exhibited breeding behavior in 15 marshes in 2004. This is the largest statewide breeding population detected since the counts began in 1980, representing an 8% increase over the former high in 1996 and a 22% increase over the 2003 total. Upper Newport Bay and Tijuana Marsh NWR were at all-time highs, together supporting 44 pairs more than in 2003. The Newport subpopulation comprised 47.1% of the state population in 2004 and together with the subpopulation in the Tijuana Marsh NWR totaled 252 pairs, or 72% of the breeding population of this rail in California.

The subpopulation at Point Mugu is now the third largest in the state with 19 pairs. Although the Seal Beach tally continued to decline, 5 of the other small subpopulation were at record or recent highs. Most notably, the Kendall-Frost Reserve supported 14 pairs and there were 11 pairs in Batiquitos Lagoon and 6 pairs in the San Dieguito River Valley.

Excluding the 4 largest subpopulations, the remaining 11 totaled 63 breeding pairs of clapper rails, 18% of the state total. The rebounding of several of the small subpopulations gives reason to believe that restoration and management can work for the Light-footed Clapper Rail.

92 THE STATUS OF WESTERN SNOWY PLOVERS IN COASTAL SOUTHERN CALIFORNIA

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Historically, coastal Southern California supported one of the largest breeding and wintering populations of Western Snowy Plovers (*Charadrius alexandrinus nivosus*) along the Pacific Coast. Human population growth and easy access to beaches has resulted in most historical snowy plover breeding habitat being converted to recreational uses. Today, breeding Western Snowy Plovers are distributed among four major sites in coastal southern California: Bolsa Chica Ecological Reserve, the Santa Margarita River mouth, Batiquitos Lagoon, and the Silver Strand on the west side of San Diego Bay from Coronado to the U.S./Mexico border. Based on the results of a population viability analysis, the recovery goal for southern California is 500 breeding adults. The 2004 breeding season window survey counted 281 breeding adults in the region, which is likely an underestimate, but continues a five year trend of increasing numbers. Wintering numbers have increased slightly over the past five years, with the largest wintering flocks located at Zuma State Beach, the Santa Margarita River mouth, the Silver Strand, and the Tijuana River mouth. Winter totals have increased from 833 birds in 2003, to 847 in 2004, to 894 in 2005. The major limitations to population growth include nest predation and lack of suitable breeding habitat. Efforts to restore beach habitat are underway but are constrained by the intense recreational uses of beaches year round and beach raking that removes foraging and breeding habitat.

93 DIETARY RESPONSE OF THE ELEGANT TERN (*STERNA ELEGANS*) TO CHANGING OCEAN CONDITIONS AND PREY POPULATIONS IN SOUTHERN CALIFORNIA

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We compared the diets of Elegant Terns at three nesting sites in southern California in 2004 to help determine whether ocean conditions have shifted from a warm to a cool regime since 1999 and therefore whether this abundant seabird can indicate oceanographic regime changes. Previous studies

have shown that the northern anchovy is a major prey species for this tern, but during warmer years the Pacific sardines can become a more important prey species. If the ocean is now in a cool regime, we expected a higher anchovy to sardine ratio in this tern's diet at all three sites, but more pronounced at the two northerly locations (Los Angeles Harbor and Bolsa Chica Ecological Reserve). We also expected Elegant Terns to have a broader diet at the more southerly site (San Diego Salt Works) because of a subtropical influence. Diets were assessed by identifying fish dropped by the birds or regurgitated by the young during parent-chick feeding encounters at the colonies. The anchovy to sardine ratios from the Los Angeles and Bolsa Chica samples were significantly larger than the San Diego site. Prey composition, but not prey diversity, also differed significantly among sites. Based on a Pacific Decadal Oscillation (PDO) index, dietary species composition from 1993 to 2004 at Bolsa Chica differed significantly between years of cooler and warmer conditions. Our work to date shows apparent influences of climate on prey availability and Elegant Tern diet in the region, but we are continuing our analysis to resolve the picture.

94 GAS EXCHANGE RESPONSES TO PULSE RAIN EVENTS BY A NATIVE HAWAIIAN DRY FOREST VINE AND THE EFFECT OF INTERACTION WITH NON-NATIVE GRASSES

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The dry forests of Hawaii have experienced reduced seedling recruitment since invasion by *Pennisetum setaceum,* a C_4, perennial bunch grass native to Africa. Precipitation in these forests is spatially and temporally variable at the seasonal and annual scales. In a common garden experiment we examined the use of pulse rain events by seedlings of *Canavalia hawaiiensis* a vine native to the Hawaiian dry forest. *Canavalia* seedlings (grown with and without the presence of *Pennisetum*) received simulated pulse rain events of five sizes and their gas-exchange responses were monitored. Plants responded to water pulses of as little as 5 mm, but at least 20 mm was required for a lasting ($\geq$3 day) response. However, in the presence of *Pennisetum,* responses were lower and shorter lived, suggesting that in the presence of the *Pennisetum* additional water input is required for the gas exchange plateau to be reached. These results suggest that the reduction of native seedling recruitment can partly be explained by altered resource dynamics, specifically pulse moisture utilization, due to invasion by *Pennisetum.*

95 BORN AND RAISED IN SOUTHERN CALIFORNIA: DEVELOPMENTAL EVOLUTION AND CRYPTIC SPECIATION IN THE SEA SLUG GENUS *ALDERIA*

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Variable development within a single species (poecilogony) is a rare phenomenon, and putative examples often comprise cryptic species. The sacoglossan genus *Alderia* contains a single recognized species in north Atlantic and Pacific estuaries; it produces feeding larvae (planktotrophy) throughout its distribution except in California, where both planktotrophy and lecithotrophy (non-feeding larvae) are expressed. Molecular, morphological and developmental evidence indicate that populations south of Bodega Harbor comprise a true poecilogonous species, distinct from the strictly planktotrophic congener *A. modesta.* Northern populations (Bodega to Vancouver) consist of large adults with a smooth dorsum that produce planktotrophic larvae; those from Tomales Bay south consist of smaller adults with a raised dorsum that seasonally toggle between planktotrophy and lecithotrophy. Sequences of the mitochondrial cytochrome oxidase I gene were obtained from 204 individuals from 14 populations. Northern and southern haplotypes formed reciprocally monophyletic clades differing by 16–20%, including fixed differences at 36 of 480 sites. Molecular clock calibration indicates the species have diverged since the early Pleistocene (1.4 million years ago). The northern species is absent from the south of Tomales Bay yet common only 4 km away, and was rare in San Francisco Bay until recruiting in large numbers in Feb. 2005; population dynamics may reflect differential colonization of, or adult survival on, regionally distinct strains of the host algae *Vaucheria* spp. Southern *Vaucheria* strains may limit slug body size, selecting against planktotrophy in the southern species by limiting fecundity in the face of high planktonic mortality.

96 SHALLOW SURF RIDERS: SMALL-SCALE LARVAL DISTRIBUTION IN ESTUARINE WATERS

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Larval supply to settlement sites strongly affects the distribution of marine organisms, but it is unclear how physical properties of the water column influence larval abundance at small spatial scales. We measured the near-bottom concentration of larvae over shallow mudflats in Newport Bay and the Cabrillo Wetland, San Pedro. For 12 months, larvae were sampled 1–10 cm above the substratum over a 3 hr flood tide for 3 consecutive days per month per site. Larvae were sorted live, grouped by taxon and identified to genus or species by DNA sequencing. Day-to-day variance in larval abundance was unexpectedly high, and concentrations were often radically skewed between the 2 heights on a given day, but evenly or reverse-distributed the next day. Such changes in small-scale distribution were observed for all major taxa, although spionid and barnacle larvae were consistently more abundant at 5 cm. Overall abundances at Newport were 3× higher for veligers, 17× higher for spionids, and 31× higher for pediveligers than at Cabrillo, whereas barnacle nauplii were 5× more abundant at Cabrillo. Flow measurements were recorded near the bed using an Acoustic Doppler Velocimeter (ADV) during sampling, revealing complex oscillatory flows; hydrodynamics may cause near-bottom fluctuations in larval abundance.

97 RAPID ASSESSMENT OF TERRESTRIAL AND MARINE HABITATS USING TWO NOVEL METHODS FOR ESTIMATING THE DENSITIES AND DISTRIBUTIONS OF ORGANISMS

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Two novel plotless mathematical solutions for rapidly estimating the densities and distributions of organisms are proposed. The accuracy and precision of these estimations using these equations were compared to those obtained by methods commonly used in the field, including both line transect and nearest neighbor methods as well as stratified random quadrat sampling and belt transect sampling. The performances of both the novel and established methods were determined by estimating densities and distributions on simulations with varying sizes and dispersions of an organism. Field tests of the methods were then conducted in the chaparral habitat in Santa Clarita, CA as well as in the rocky intertidal zone at White's Point, CA. In both the simulation and field tests, the proposed methods often produced more precise and accurate estimates of densities, and to a lesser extent distributions, than the other methods. The novel equations were also more robust than established methods in terms of more accurate density estimations when using varying sample sizes and organism dimensions.

98 ON SOUTHERN CALIFORNIA ABYSSAL ECHINODERMS

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Echinocrepis rostrata Mironov, 1973 is an abyssal echinoid found in the northwest Pacific and in the eastern Pacific from Alaska to Mexico at depths of 3315 to 5020 meters. There are two distinct morphological types, one in the northwest Pacific and one in the northeast Pacific south to 34° N. Specimens of *E. rostrata* in the Scripps Institution of Oceanography Benthic Invertebrate Collection are of the morphological type found in the northeast Pacific. *Cystocrepis setigera* (A. Agassiz, 1898) is an abyssal echinoid found in the eastern Pacific from Alaska to Peru at depths of 2330 to 4100 meters. There is a collecting record for *C. setigera* in the central north Pacific at the Magellan Rise seamount (7° N 176° W; 3100 m). This is the only non-eastern Pacific record for this species and this may be due to the lack of sampling west of the eastern Pacific continental shelf. In the Peru trench *C. setigera* has a high level of ectosymbiosis; however, individuals of this species off the central California coast show that ectosymbionts are either extremely low in number or absent. *Pythonaster pacificus* Downey, 1979 is an abyssal asteroid described from a single specimen collected off southern California (31° 19.7′ N 119° 39.2′ W; 3600 to 3676 m). An additional specimen of this species is in the Scripps Institution of Oceanography Benthic Invertebrate Collection (32° 03′ N 120° 30′ W; 3777–3792 m). A live *P. pacificus* has been seen in camera sled imagery partially buried in mud (34° 42.11′ N 123° 11.185′ W; 4100 m).

99 THE DEEP SEA HOLOTHURIAN *SCOTOPLANES GLOBOSA* OFF SOUTHERN CALIFORNIA

K.D. Trego. Nautilus Oceanic Institute, La Jolla, CA 92037

Scotoplanes globosa Théel, 1879 is a cosmopolitan deep sea holothurian found at depths of 545 to 7710 meters. The aggregate behavior of this species is well documented as mobile grazing aggregations of *S. globosa* feed on kelp falls, detrital deposits, and whale falls. The aggregate behavior of this species is also well documented in the Santa Catalina Basin and San Diego Trough. These are bathyal basins where *S. globosa* is found to be common. *Scotoplanes globosa* was studied in the Santa Catalina Basin by submersible at 1300 meters and in the San Diego Trough by at 1243 meters. Large numbers of *S. globosa* taken in single trawls may indicate aggregate levels present at the trawl sites. The Scripps Institution of Oceanography Benthic Invertebrate Collection has large single trawl lots for *S. globosa* from the San Diego Trough, Tanner Basin, and East Cortez Basin at depths between 1200 to 1400 meters. There is also a large single trawl lot for San Nicholas Basin at 1738 meters. Tanner Basin, East Cortez Basin, and San Nicholas Basin may be additional bathyal basins where *S. globosa* may be found in feeding aggregations.

100 TOOLS FOR TRACKING THE FATE OF WASTEWATER-DERIVED CONTAMINANTS IN EFFLUENT-DOMINATED WATERS

David L. Sedlak. University of California, Berkeley, CA

Municipal wastewater effluent contains low concentrations of a variety of chemical contaminants of concern to human health and aquatic ecosystems. Some of these compounds are difficult to measure with conventional analytical methods. To track the sources and fate of wastewater-derived contaminants in surface waters, we have developed a suite of tracers that can be used to assess dilution and transformation reactions that occur in the aquatic environment. For example, enantiomers of the human pharmaceutical propranolol can be used to differentiate between untreated sewage and wastewater effluent because the compound undergoes enantiomer-selective degradation in wastewater treatment plants. This tracer can be used to identify sites where leaking sewers or combined sewer overflows impact water quality. Total organic iodine can be used as a tracer for the fraction of a water sample that is derived from wastewater effluent because the main sources of organic iodine are the X-ray phase contrast media used in medical imaging. In a similar manner, wastewater-derived contaminants that are known to degrade by different mechanisms (i.e., reactive tracers) can be used to assess contributions of contaminants from combined sewer overflows and the transformation of contaminants by processes such as photochemical reactions and biotransformation. Application of these techniques should provide a better understanding of how wastewater-derived contaminants are attenuated in the aquatic environment and in engineered treatment systems.

101 CONTAMINANT FATE AND SOURCE TRACKING USING CHIRAL AND STABLE ISOTOPE ANALYSIS

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Toxic organic contaminants continue to pose ecological and human health risks in coastal urban systems, however, identifying their sources and tracking their fate in complex watersheds remains challenging. For constituents of legacy and currently registered biocides that are chiral (e.g. DDT, toxaphene, cypermethrin), enantioselective GC- and LC-MS allows for quantification of enantiomer abundances/ratios, proxies for determining the extent of biotransformation acting on these compounds. Another powerful diagnostic tool is compound specific isotopic analysis (CSIA) where, for example, stable isotopes of carbon associated with individual chromatographic peaks are quantified after combustion to CO_2. The underlying principle for applying CSIA is that stable isotope ratios (e.g. $\delta^{13}C$) shift when chemical bonds of the parent compound are broken, e.g. as a result of microbially-mediated enzymatic reactions. On the other hand, unchanging $\delta^{13}C$ values in a given watershed suggest little in situ transformation. These tools are being developed and applied in coastal environmental research to track and apportion contaminant sources, and to characterize the contaminant biotransformation potential of species, communities and ecosystems.

102 CHEMICAL METHODS FOR MEASURING BIOAVAILABILITY

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In multi-phase matrices, phase distribution determines the bioavailability and hence the ecotoxicological effects of a contaminant. For a hydrophobic pollutant, it is well recognized that its availability for bioaccumulation or toxicity is reduced due to association with colloidal particles and dissolved organic matter (DOM). The reduction in bioavailability is influenced by both the quantity and quality of the colloidal and DOM phases. As the fine colloids and DOM are essentially inseparable from the aqueous phase, quantifying bioavailable concentrations is a great challenge. This presentation will discuss several tested physical-chemical approaches for measuring bioavailability of hydrophobic organic contaminants, and their advantages and limitations. The second half of this talk will introduce solid-phase microextraction (SPME) and its unique applicability for detecting bioavailable concentrations. Studies show that SPME fibers mimic membranes or lipids of organisms, and chemical accumulation in the SPME fiber is parallel to bioaccumulation or toxic effects observed in test animals. SPME can therefore be used as a "biomimetic" surrogate to estimate contaminant bioavailability in sediment porewater, soil, runoff effluents, or "brown" surface water.

103 WATER QUALITY ON SWIMMING BEACHES: NEW DIRECTIONS FOR THE EUROPEAN UNION

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On 24 October 2002, the European Commission adopted a proposal for a revised Directive of the European Parliament and of the Council concerning the Quality of Bathing Water on swimming beaches in the European Union. This proposal is called COM 581 and is part of a sweeping 3rd wave of water directives, changing the face of environmental policy in Europe. Since the original directive was published there have been many changes to science, technology and the management of the environment. Within Europe since the early 1990s there has been a progressive move towards assessing water bodies holistically rather than just addressing human inputs and concerns. With new approaches, competent authorities such as water providers, environmental protection agencies and local authorities face new challenges to develop the systems that are prescribed in the new directive. Success in this is critical to best practice within coastal management and the associated social, economic and environmental aspects. The overall aim of my research is to develop methods and approaches to support the competent authorities involved, through a Bathing Water Management Framework (BWMF). Using an inter-disciplinary model, this paper shall explore the three areas of greatest change in bathing water policy. These are: legislation and management development, biomonitoring, and communication to the public. This approach will ultimately lead to the development of a framework to assist competent authorities in improving management of beaches as entire ecosystems that are safe for human use.

104 CONTAMINANT TRENDS IN THE SOUTHERN CALIFORNIA BIGHT: A MUSSEL WATCH UPDATE

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Since 1986, mussels from about 21 sites in the Southern California Bight have been analyzed for trace contaminants as part of NOAA's National Status and Trends Program. Recent data (through 2002 and 2003) show few significant changes to trends through 1998–1999 we reported in the 2002 SCAS conference. With one notable exception, concentrations of organochlorines (PCBs, DDTs and other pesticides) and butyltins (from antifouling paints) continued to decline through 2002/2003. Whereas concentrations of PCBs were below 200 ppb dw at most sites, those at two sites in San Diego harbor remained elevated above 1000 ppb dw. The highest concentrations of DDTs in 2002/2003 (753 ppb dw) occurred at San Pedro Fishing pier inside the LA/LB Harbor breakwater, with concentrations decreasing by 1–2 orders of magnitude upcoast and downcoast (e.g., 11.7 ppb dw at Point Loma). Nonetheless, since 1990 concentrations of DDT in mussels from all 21 stations declined an average of 53% (range 13 to 87%), giving a regional half-life of about 10 years. Chlordanes, heptachlors, and several other organochlorines compound classes remain measurable at low concentrations. Total polycyclic aromatic hydrocarbons (sum of over 40 PAHs) show continued elevated concentrations at

several sites, with fingerprints suggesting dominance of pyrolytic sources. Trace metal concentrations have changed little over the past two decades, with the notable observation of higher cadmium concentrations at remote sites. Continued monitoring, coupled with comparison to chemical mass inputs from major sources (point, nonpoint) could reveal the effectiveness of pollution control efforts during the past two decades.

105 A COMPARISON OF TRACE METAL CONCENTRATIONS IN DEEP OFFSHORE AND NEARSHORE SEAWATER FROM SOUTHERN CALIFORNIA

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An important route for the uptake of trace metals into marine organisms is dissolved metals directly from their environment. Results for trace metals using extraction/chelation followed by ICPMS analysis will be compared between deep offshore seawater (800m) and nearshore harbor seawater. The concentration of several elements were significantly higher in the harbor water. The concentrations will also be compared to the several reference sources for seawater metals concentrations and the California Ocean Plan requirements. Finally, for the nearshore samples a comparison of the dissolved versus particulate metals concentrations will be presented indicating where the metals are partitioned.

106 HEAVY METAL ACCUMULATION IN SEA TURTLES FROM THE BAJA CALIFORNIA PENINSULA, MEXICO

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Heavy metals were assessed in four species of sea turtles from the Baja California Peninsula, Mexico, representing the first report of heavy metal concentrations in tissues of post-yearling sea turtles from the Eastern Pacific. Concentrations of Cd measured in C. mydas kidney (652.57 μg/g) were the highest ever reported for any sea turtle species. Cd accumulated preferentially in kidney and the range of kidney to liver Cd ratios in Baja California turtles were among the highest reported for sea turtles globally. Zn, Ni, and Mn concentrations were also significantly higher in kidney than other tissues, while Cu and Fe were greatest in liver, and all metals were lowest in muscle. With the exception of one value (69.9 μg/g in kidney of C. caretta), Pb was low in all tissues from Baja California. In comparisons across species, kidney of C. mydas had greater Zn and Ni concentrations as compared to other species, although there was no difference in liver metal levels among the species. Positive correlations were detected in the concentrations of Cd, Cu and Ni with the straight carapace length of C. caretta. Potential sources of high concentrations of metals in Baja California coastal ecosystems will be discussed and compared to the US State of California.

107 PROBING METAL-LIGAND INTERACTIONS USING STABLE ISOTOPICALLY LABELED PROTEINS AND DIRECTLY COUPLED HPLC-ICP-MS

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The transcriptional induction of metallothionein (MT) by reactive oxygen species (ROS) and elevated levels of metals such as Cd, Cu and Zn has been used to support the concept that this protein can be used as a sub-cellular biomarker for metal contaminant exposure and oxidative stress. Although not explicitly stated, the basic assumption in the use of the protein in this context is that the steady-state cellular concentrations of metallothionein qualitatively or quantitatively reflect the degree of contaminant exposure in a manner that the response can provide early warnings of deleterious sublethal effects. Conceptually, this paradigm is in accordance with the proposed protective function of MT in metal or ROS detoxification. However, more recent evidence indicates that this protein family may function primarily in metal homeostasis and the redox-mediated distribution of Zn in animal cells, implying that protein expression may be uncoupled from stressor exposure. The current work describes a novel ICP-MS procedure that has been used to directly probe the functionality of MT and the ability of the two major isoforms, MT-1 and MT-2, to exchange Zn and to selectively deliver Zn and Cd in a redox specific manner to intracellular protein targets, causing both enzyme activation and inactivation. With further refinement, the technique has the potential for studying the synergistic and antag-

onistic interactions of different metals with multiple donor and recipient proteins. It therefore offers a procedural framework for empirically testing the behaviour of more complicated scenarios of metal-ligand exchange, which is the basis for understanding the cellular toxicity of essential and non-essential metals *in vivo*.

108 STRATIFYING BAY AND ESTUARY HABITATS OF THE WEST COAST OF THE CONTIGUOUS USA: A STEP TOWARD REGIONAL INDICATORS OF BENTHIC COMMUNITY CONDITION

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We identified benthic assemblages occurring naturally in soft bottoms of bays and estuaries of the west coast of the contiguous US and evaluated the importance of geography and habitat in structuring them. Species abundance, habitat and contaminant data from 1318 samples collected by five regional and coast wide projects were adjusted for compatibility and combined. Because our objective was to define natural groupings of samples, potentially polluted sites were eliminated. Assemblages were then identified by hierarchical cluster analysis of species abundances in the 714 remaining samples. Latitude, salinity, grain size distribution and depth values were tested across dendrogram splits to assess whether the assemblages occupied different geographic regions or habitats. Overall, eight assemblages were identified, structured primarily by salinity, geography and sediment grain size. Geographically distinct high salinity assemblages were identified in southern California, Puget Sound and the west coast from central California to Washington State. In contrast, transitional salinity and freshwater assemblages were widely distributed along the coast. These assemblages may be viewed as alternate, habitat-dependent states of reference condition that can be used to identify impaired benthos. Most likely, regional indicators of benthic invertebrate community condition will differ from assemblage to assemblage.

109 INFESTATION OF PARASITIC COPEPODS AND THE POTENTIAL OF STRESS ON HOST FISHES

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While it is widely known that the southern California marine environment has been subjected to numerous inputs of pollution, little is known about the effects of pollution on infestation of parasites on marine fishes. Exposure to pollution may result in stress, which may potentially decrease the immune response in fishes and increase their susceptibility to diseases and parasites. A variety of marine organisms have been evaluated as potential biological indicators of various forms of pollution in the aquatic environment. However, due to the range of contaminants to which marine organisms are exposed, it is unclear which organisms and which anomalies are best used as indicators. In addition, it is unclear to what degree parasites cause stress to their host and what long term damage occurs to host physiological responses. Chronic stress can inhibit an organism's normal physiological response to the environment. Thus, fishes may be subjected to two major forms of environmental stress; parasites and poor water quality. The California scorpionfish, *Scorpaena guttata,* is common in southern California and is frequently infested with parasitic copepods. Intensity levels of parasitic gill copepods, *Naobranchia scorpaenae,* vary per host and can sometimes be as high as 100 copepods per gill cavity. Levels of the stress hormone cortisol and infestation levels of ectoparasites were compared from scorpionfish collected at various predetermined stations in southern California. Sampling occurred near the Orange County Sanitation District wastewater outfall. Preliminary results suggest an abnormal response in cortisol levels in groups of fish with high parasite prevalence.

110 DISRUPTION OF THE STRESS RESPONSE ENDOCRINE SYSTEM IN MARINE FISHES IN THE SOUTHERN CALIFORNIA BIGHT

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Connections between environmental contamination and impairment of endocrine mechanisms regulating key physiological systems in marine fishes are not understood, particularly in southern California. All vertebrates respond to environmental stressors via a highly integrated neuroendocrine response system which, in fish, is referred to as the hypothalamo-pituitary-interrenal (HPI) axis. Activation of the HPI axis results in synthesis and release of the steroid hormone, cortisol, into the blood circulation and, depending on the nature and severity of a stressor and the fish species tested, plasma cortisol concentrations may increase up to 200-fold over basal levels. In our studies in fish from the Bight, we have identified instances in which the HPI axis shows severely blunted responses, including after conditions of chronic stress in captive fish and in fish captured in the vicinity of wastewater treatment plant outfalls. This impairment of the stress response system may occur at one or more levels of the HPI axis, in addition to possible alterations in steroidogenic or metabolizing enzyme expression. Our studies, aimed at these questions, will be addressed.

111 GROWTH ENDOCRINE DISRUPTION IN SOUTHERN CALIFORNIA MARINE FLATFISH

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Our research to date indicates that important endocrine systems may be altered in marine flatfish of southern California. One of these systems, that which regulates somatic growth and a host of related anabolic functions, is the insulin-like growth factor (IGF) axis. Increased circulating levels of IGF-I and IGF-binding protein-3 (IGFBP-3) promote growth, while decreased IGF-I levels combined with increased levels of IGFBP-1 are characteristic of growth inhibition. IGFBP-1 has a high IGF-I-binding affinity and blocks IGF-I activation of target cell receptors, and it is up-regulated by the stress hormone, cortisol. IGF-I expression and plasma levels, on the other hand, may be inhibited by cortisol, estrogens or other compounds. In flatfish caught in certain locales in the southern California bight, IGF axis alterations occur in individuals exhibiting impaired stress responsiveness (neuroendocrine HPI axis), while putative relationships between the IGF axis and plasma estradiol are less clear.

112 BIOACCUMULATION OF CONTAMINANTS IN RECREATIONAL AND FORAGE FISHES IN NEWPORT BAY, CALIFORNIA IN 2000–2002

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Newport Bay is an important southern California estuary that is both a developed marina in its lower bay and an ecological reserve in the upper bay. Recreational anglers catch fish for consumption, particularly in the lower bay, and threatened bird species consume small forage fish in the upper bay. The objectives of this study are to 1) provide recent data on contaminant levels in Newport Bay fishes, 2) identify species with concentrations posing potential health concern to humans or wildlife, and 3) identify species or ecological groups of fishes with high concentrations. Target contaminants included semivolatile organic compounds (DDTs, other pesticides, and PCBs) and trace metals (arsenic, mercury, selenium, and cadmium). Fourteen recreational and nine forage fish species were analyzed for these contaminants. Many fishes of Newport Bay have tissue contaminant levels above screening values (SVs) for human or wildlife fish consumption. DDT was the most widespread contaminant of concern in fish tissue, followed by PCBs. Five recreational fish species were above the human health SV for DDT and three for PCBs. All nine forage fish species were above the SV for wildlife health for DDT but only three were above that for PCBs. Three forage fish species had selenium levels above the wildlife SV. Although DDT was widespread in all species, other contaminants were associated with ecological types of fish. Although DDT, PCB, and selenium levels in some species are

still of concern, concentrations of these contaminants have declined substantially during the past 25 years.

113 OXIDATION OF SELENOMETHIONINE BY FLAVIN-CONTAINING MONOOXYGENASES (FMOS)

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Selenium biotransformation into organoselenium forms by primary producers and subsequent accumulation by higher food chain organisms such as fish are critical for mechanistically understanding the adverse effects of selenium in aquatic organisms. Although previous laboratory and field studies have both demonstrated a good correlation between adverse effects and total selenium in fish tissue, direct confirmation of the most toxicologically important forms of organoselenium is lacking, with nearly all measurement being total selenium. To illustrate this, we hypothesize that following accumulation by fish organoselenides are oxidized to selenoxides by flavin-containing monooxygenase (FMO) upon the consumption of NADPH and oxygen. The generated selenoxide can be reduced to organoselenide by consuming the antioxidant glutathione. With the continuous redox cycling between organoselenide and selenoxide we hypothesize, glutathione will be depleted eventually resulting in cellular toxicity. Therefore, in this study, an *in vitro* substrate dependent NADPH oxidation assay was performed to test the first step of the hypothesis, the oxidation of organoselenium by FMO. A series concentration of the organoselenide selenomethionine (0.05 2.0 mM) was incubated with 0.2 mM NADPH and 100 μg microsomal FMO1 or FMO3 proteins in 50 mM KPO4 buffer (pH 8.4) at 37 C. The absorbance of NADPH (340 nm) of the reaction mixture was measured over 30 min at 5 min intervals, and a NADPH extinction coefficient of 6220 M-1 cm-1 was used in calculating catalytic constants. The results show that both FMO1 and FMO3 demonstrate catalytic activity for selenomethionine, with FMO3 having a lower Km than FMO1 (i.e, 172 μM and 617 μM, respectively), indicating that FMO3 is more reactive in catalyzing the oxidation of selenomethionine to the oxide.

114 ENANTIOSELECTIVITY IN PYRETHROID DEGRADATION IN SOIL

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Synthetic pyrethroids contain two or three chiral centers, making them a family of pesticides with the highest number of enantiomers. Our recent study showed significant differences in aquatic toxicity between the stereoisomers of the same compound. To better understand the ecotoxicological effect and fate of synthetic pyrethroids, chirality in biodegradation of pyrethroid compounds should be also considered. In this study, enantiomers of *cis*-bifenthrin were isolated on chiral HPLC and the enantiopure isomers were examined individually for degradation rate in two soils under the same conditions. Degradation of each enantiomer was studied at 20°C under both aerobic and anaerobic conditions. The study results show that R-*cis*-bifenthrin degraded faster than S-*cis*-bifenthrin under aerobic conditions in both soils. However, under anaerobic condition, S-*cis*-bifenthrin was found to have a faster degradation rate. Isomer conversion did not occur during degradation in soil. As only biological interactions can be chiral selective, the enantioselectivity observed in degradation of *cis*-bifenthrin should be a result of different microbial communities under different test conditions.

115 ENANTIOMERIC SULFOXIDATION OF THE ORGANOPHOSPHATE PESTICIDE FENTHION IN FISH

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The objective of this study is to examine the enantioselective sulfoxidation of fenthion, in liver microsomes of various fish species (rainbow trout, hybrid striped bass, tilapia). Microsomes from striped bass, trout, and tilapia primarily formed (-) sulfoxides in approximately 65% enantiomeric excess. Enzyme inhibitors lubrol (cytochrome P450) and methimazole (Flavin Monooxygenases) were used to determine sulfoxide relative contributions from each enzyme system. In striped bass microsomes, P450 was responsible for 74% of sulfoxide formation. Co-incubation with methimazole or lubrol in trout liver microsomes enhanced sulfoxide formation. Salt water treatments which typically induce FMOs, did not significantly alter enantioselectivity or rates of fenthion sulfoxidation, even though toxicity tests indicated that saline environments enhanced the toxicity of fenthion in trout.

These results indicated either the formation of additional metabolites of fenthion or the contribution of additional oxygenases to S-oxidation.

116 LINKING BIOMARKER RESPONSES AND PHYSIOLOGICAL STRESS TO GROWTH IMPAIRMENT OF CADMIUM-EXPOSED LARVAL TOPSMELT

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An integrated approach was used to determine if key biochemical, cellular, and physiological responses were related to growth impairment of cadmium (Cd)-exposed larval topsmelt (*Atherinops affinis*). Food intake, oxygen consumption rates, apoptotic DNA fragmentation (TUNEL assay), and metallothionein (MT)-like protein levels, were separately measured in relation to growth of topsmelt aqueously exposed to sublethal Cd for 14 days. Cadmium accumulation and abundant metal concentrations in topsmelt also were evaluated. Final mean weight and length of Cd-exposed topsmelt were reduced relative to those of control fish. Food intake was weakly correlated with weight of Cd-exposed topsmelt. Oxygen consumption rates were positively correlated with Cd concentration and inversely correlated with weight of topsmelt. Apoptotic DNA fragmentation was elevated in the gill of fish exposed to 50 ppb Cd, and in the gut, gill, and liver of fish exposed to 100 ppb Cd. Metallothionein-like protein levels were significantly elevated in fish exposed to 100 ppb Cd. Oxygen consumption rates may have increased as a compensatory response to Cd exposure; however, the energy produced was likely allocated to an increased metabolic demand due to apoptosis, MT synthesis, and ion regulation changes. This diversion of energy expenditures could contribute to growth impairment of Cd-exposed fish. The integration of biomarker responses across levels of biological organization will advance our understanding of mechanisms through which fitness becomes impaired.

117 ARTHROGRYPOSIS FOLLOWING ACRYLAMIDE EXPOSURE

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Arthrogryposis multiplex congenita (AMC) is a term that is used to describe the presence of multiple joint contractures at birth. AMC is a syndrome, involving many fetal and neonatal disorders of the neuromuscular systems. The mother of the subject worked in a biomedical laboratory using polyacrylamide gels in electrophoretic studies of nucleic acids. Working without respiratory protection throughout her entire pregnancy, she experienced her greatest exposure to the monomer, acrylamide. Exposure to acrylamide throughout the mother's pregnancy is judged to be the etiology of the subject's arthrogryposis. This is the first occupational prenatal exposure to the monomer acrylamide to be implicated as a possible etiologic agent in a case of arthrogryposis.

118 EXPRESSION AND CHARACTERIZATION OF CHANNEL CATFISH CYP 2X1

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Previous studies of channel catfish identified a novel cDNA encoding the cytocrome P450 isoform, CYP2X1. To better characterize CYP2X1, the protein was expressed in Sf9 cells and examined for catalytic ability. A pFastBac ™ 1 donor plasmid, containing the CYP2X1 reading frame, was transferred to the bacmid DNA (Baculovirus genome) at the Tn7 site-specific transposition in DH10Bac competent cells. Isolated microsomes from Sf9 cells demonstrated a maximum CO reduced spectrum at 450nm, and exhibited a band at approximately 57 kD on SDS-PAGE. CYP 2X1 catalyzed Benzphetamine and Aminopyrine demethylase activity at 0.1888 nmol/min and 0.043 nmol/min respectively. However, enzymatic activity was not observed following incubation with p-Nitrophenol, Fenthion, Benzylresorufin or Pentoxyresorufin. These results indicate CYP2X1 displays activities consistent with other piscine CYP2 isoforms.

119 IDENTIFYING ALUM AS A TOXICANT IN WHOLE EFFLUENT TOXICITY TESTS

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Alum (aluminum sulfate) is a commonly used flocculant in the wastewater treatment process. Dosing levels of alum are made at the discretion of POTW's based upon several water quality factors. Chronic effects were observed in the cladoceran *Ceriodaphnia dubia* and the green algae *Selenastrum capricornutum* during routine testing of tertiary treated effluent from a municipal wastewater treatment plant. Several consecutive toxic samples prompted a Toxicity Reduction Evaluation (TRE) at the plant, whereby Phase I Toxicity Identification Evaluation (TIE) tests indicated higher sensitivity in *Selenastrum* to the effluent than *Ceriodaphnia,* with no effects observed in *Pimephales promelas.* Filtration reduced the toxicity of the effluent in Phase I TIE tests using *Ceriodaphnia,* and subsequent Phase I TIE fingerprint tests of several compounds showed alum to produce patterns consistent to the effluent in terms of dose response, species sensitivity and toxicity reduction by filtration. The dose response levels appeared consistent with the average daily dose of alum at the treatment plant, and additional tests in which laboratory control water was diluted to match the hardness of the effluent showed even lower dose response levels in *Selenastrum.* The observed physical effects of alum on the green algae included clumping of multiple cells and decreased cell counts. This provides a possible mechanism for the chronic effects in *Ceriodaphnia,* which uses *Selenastrum* as a food source, and may explain the insensitivity of *Pimephales* to the effluent, which uses a larger, multicellular food source. Reduced alum dosing at the plant in response to this study appeared to confirm these findings, as subsequent effluent tests showed no chronic effects in either *Ceriodaphnia* or *Selenastrum.*

120 DEVELOPMENT OF A MACROINVERTEBRATE IBI FOR SOUTHERN COASTAL CALIFORNIA AND USE OF PROBABILISTIC SAMPLING FOR REGIONAL STREAM CONDITION ASSESSMENTS

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We developed a macroinvertebrate index of biological integrity (IBI) for the arid and populous southern California coastal region. Potential reference sites were screened from a pool of 238 sites with quantitative GIS landscape analysis and with reach-scale physical habitat assessments. We evaluated correlations among a suite of potential stressor gradients to identify a set of 10 independent reach, local and watershed scale stressors. To select component metrics for the IBI, we screened 61 candidate metrics for suitability with regard to three criteria: sufficient range for scoring, responsiveness to the 10 stressor gradients and minimal redundancy with other responsive metrics. Seven final metrics (Percent Collector-Gatherer + Filterers, Percent Non-insect Taxa, Percent Tolerant Taxa, Coleoptera Richness, Predator Richness, Percent Intolerant Individuals and EPT Richness) were scored and assembled into a composite IBI which was then divided into five equal condition categories. Three metrics had lower scores in chaparral reference sites than in mountain reference sites and were scored on separate scales in the IBI. A separate repeatability study and application of the IBI to an independent validation dataset confirmed that IBI scoring is highly consistent. Data from probabilistically selected sites allowed us to develop a defensible condition assessment for streams in the region.

121 ALGAE-NUTRIENT RELATIONSHIPS AND TMDL DEVELOPMENT IN MALIBU CREEK, CALIFORNIA

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Periphyton cover in Malibu Creek was sampled in spring and fall. Multiple regressions of periphyton cover with nutrients, canopy cover and substrate size indicated nutrient concentrations were most often related to periphyton cover, and canopy was the next most important factor after nutrients. Nutrient concentrations in the water and percent cover of periphyton were lower at reference sites than at impacted sites. Relationships between periphyton cover and nitrate concentration, phosphate concentration and canopy cover varied seasonally. Nitrate concentration had the strongest relationship with macroalgal cover in the spring and phosphate concentration had the strongest relationship with ma-

croalgal cover in the fall. Phosphate was consistently positively related to microalgal cover regardless of season. Nitrate was sometimes positively and sometimes negatively related to microalgal cover.

122 FRESHWATER STREAM INVERTEBRATES: RESPONSE TO PHYSICAL HABITAT ALTERATION AND WATER QUALITY IMPAIRMENT IN SOUTHERN CALIFORNIA

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Biomonitoring of the benthic macroinvertebrate communities has become a widely used tool to monitor the effects of non-point source pollution in urban runoff. In coastal Southern California, physical alteration of natural drainages in the form of impervious surfaces and lined flood control channels has compounded the issues of biomonitoring, as the degraded physical habitats are not considered ideal for biological uses. Interpretation of biomonitoring results in drainages with physically altered habitats becomes difficult when water quality and physical habitat quality must be weighed to determine which has a greater effect on use attainability by the macroinvertebrate community. Three regional stream bioassessment monitoring programs were conducted in Los Angeles, Orange, and San Diego Counties in October of 2003 as required for municipal NPDES permit compliance. A total of 54 monitoring sites from 22 different watersheds were assessed using the California Stream Bioassessment Procedure (Harrington 1999). Data analysis incorporated a recently developed Southern California Index of Biotic Integrity (Ode et al In Press) to rate quality of benthic macroinvertebrate communities. Physical habitat quality was quantified using EPA Rapid Assessment protocols. Results of our studies indicate that the biological integrity in urban affected watersheds in Southern California has been substantially degraded. We have also determined that while physical habitat may limit macroinvertebrate colonization to some degree, the lowest quality communities did not occur in the most altered or poorest quality physical habitats. Correlating the quality of the physical habitats of streams and the quality of the benthic communities they support indicates that there is little relationship in the presence of urban runoff.

123 THE APPLICATION OF STREAM BIOASSESSMENTS IN POINT AND NON-POINT SOURCE REGULATORY PROGRAMS

Scott Johnson

No abstract available.

124 USE OF *IN SITU* HATCHBOX STUDIES TO EVALUATE WATER QUALITY EFFECTS

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Laboratory toxicity tests have been criticized on the basis that their results may not reflect site-specific conditions. Conversely, interpreting the results of bioassessment studies may be problematic due to the inability to control for the movements of organisms in the receiving environment, as well as difficulties distinguishing between water quality and habitat effects. Thus, the use of *in situ* studies may provide an opportunity to quantitatively evaluate the potential effects of a discharge under the conditions found in the actual receiving environment. This presentation describes the approach used at the Myra Falls mine to evaluate the potential for discharge effects in the receiving environment. Eyed trout embryos were placed in hatchboxes at different locations to identify any potential for toxicity in Myra Creek. The reference site was located upstream of the discharge, and potential impact sites were located downstream of the discharge. Hatchboxes were also placed at selected locations to identify possible inputs of contaminated subsurface flows. Both lethal and sub-lethal endpoints were evaluated, including survival, hatching success, and growth.

125 THE EFFECTS OF SEQUENCING: MEMORY ITEMS VS. PERCEPTUAL LEARNING

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This study examined adaptive learning as it pertains to learning of memory items and perceptual learning. It studied how the order in which items are presented can be manipulated to make both types of learning more efficient. Fifty-four subjects completed a learning module that would teach thirteen

multiplication problems and thirty-nine subjects completed a learning module that would teach them to discriminate between ten categories of beetles. Subjects were randomly assigned to one of three conditions with different sequencing. One condition applied known laws of learning and memory of memory items to an adaptive learning algorithm that used speed and accuracy to determine which item to present. The other two conditions used random presentation. The results suggest that the adaptive learning algorithm allows for better retention than random presentation where the items no longer appear after they have been learned. Although retention is slightly better for random presentation where the items continue to appear after they have been learned over the sequencing algorithm, this requires far more trials than sequencing, making sequencing more efficient

126 CREB-MUTANT PERFORMANCE IN A NOVEL LEARNING TASK

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The cAMP responsive element binding protein (CREB) is a nuclear protein that helps in transcription of brain-derived neurotrophic factor (BDNF). Through a series of intracellular signaling events CREB activates transcription of genes with cAMP responsive elements in their promoter regions. BDNF is a neurotrophic factor transcribed within brain cells that has been shown to play a vital role in learning and neuronal survival. CREB impairment would therefore inhibit memory and recognition in mutant mice. In this experiment the Y-Maze was used to test the extent of the effects of novelty versus experience on performance in the Y-Maze and its effect on BDNF levels in mice. Results acquired so far are somewhat significant. CREB mutants were injected with 4-hydroxy tamoxifen to activate the CREB repressor. Although in some cases mutants performed just as well controls, in most cases control mice performed noticeably better than mutants.

127 OPERATIONAL EFFECTS OF ALTERED ABIOTIC FACTORS ON NITRIFYING BACTERIA: YEAR 2

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A way to easily determine the feasibility of any method of preserving water quality in a specific water body is critical for the large-scale implementation of the method. Artificial addition of nitrifying bacteria to a water body can efficiently lower concentrations of ammonia, a highly toxic nutrient. A set of abiotic factors with respect to temperature, pH, salinity, and dissolved oxygen under which the bacteria can be expected to operate optimally would be instrumental in helping naturalists considering adding nitrifying bacteria to a natural water body make the decision.

The experiment was done by changing abiotic factors in tanks containing *Nitrobacter* and *Nitrosomonas* and water collected from Salinas de San Pedro, a salt marsh. The success of the bacteria was determined by testing concentrations of ammonia and nitrates. It was hypothesized that only salinity will have an effect on the bacteria.

The results showed that this was incorrect. The two genera of bacteria in the Biozyme favored different conditions of abiotic factors. Overall, the optimum water body for the nitrifying bacteria to operate in would have a temperature of about 30°C, a pH between 8.0 and 8.3, a salinity between 22 and 27 ppt, and a dissolved oxygen content between 5 and 9 mg/L. It should be noted, however, that in almost all cases, the bacteria operated as it should under unfavorable conditions, although its processes were somewhat delayed.

128 STRAIN RELATEDNESS OF *CANDIDA* IN HUMANS: A URINARY PATHOGEN OR COLONIZER? (PHASE 2)

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Candida species are commonly found the urine of hospitalized patients. Over 50,000 persons have this condition annually in the United States. This significance of this condition, candiduria, remains controversial. There is evidence that candiduria may represent a potentially serious and deadly bloodstream infection, or, alternately, merely represent urinary tract colonization. To provide important insights into the meaning of this condition, we examined strain relatedness of Candida strains from

over 300 patients causing infections among hospitalized patients of Harbor-UCLA Medical Center last year.

METHODS: We longitudinally examined 300 hospitalized patients with candiduria from Cedars Sinai Medical Center. Among those with > 1 *Candida* strain isolated from the urine, we compared strain relatedness using usual clinical microbiological techniques and DNA fingerprinting. We hypothesized that *Candida* species would vary over time, suggesting that candiduria may represent host susceptibility to this condition rather than a persistent state.

RESULTS: Among the 300 patients, 89 had > 1 analyzable candida strain. Mean number of cultures per patient was 2.787. Of these follow-up cultures (cultures done after the initial culture positive for candida), 54 were negative for *Candida,* 47 demonstrated a different *Candida* species or strain and 147 demonstrated the same *Candida* species and strain. Four patients went on to have bloodstream infections.

CONCLUSIONS: *Candida* in the urine tended to wax and wane with time, and occasionally are supplanted with other *Candida* strains. This demonstrates that candiduria commonly resolves and recurs, occasionally with a new species. This suggests that candiduria, rather than persistent, phenomenon and that the natural history of this process appears relatively benign in most cases.

129 MAINTAINING CORRECT BALANCE: SPATIAL CODING AND ITS DEPENDENCE ON NATURAL STIMULI

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The vestibular system in the inner ear decodes motion and acceleration. The utricle's otoconia deflect hair-like protrusions in ascending order, called the morphological polarization vector. MPVs are essential for spatial coding. The project examined what effect natural stimuli have upon MPV maintenance. Otoconia deficient *HET/HET* and otoconia producing HET /+ mice utricles were used. Thus, otoconia was the sole variable. The tissues were prepared with phaloidin fluorescence and were imaged with a confocal microscope. The angle was calculated using the kinocilium center and hair cell center. In data quantification, three similar utricle areas yielded a HET/+ to HET/HET average angle of 93.3° to 105.5°, 114° to 137.5°, and 91° to 100° respectively. The compared MPV angles showed similarity, which suggests that sensory coding is non-stimuli dependent. This experiment deductively narrowed the factors contributing to MPV maintenance, so that non-stimuli factors can be explored.

130 EFFECTS OF ATMOSPHERIC CARBON DIOXIDE ON THE NITROGEN FIXATION CAPABILITIES OF *TRICHODESMIUM*

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As a consequence of the rising levels of anthropogenic carbon dioxide in the atmosphere, the world ecosystems are undergoing unforeseen changes. The nitrogen cycle constitutes as one of the most important processes within the biological world, with nitrogen being one of the twenty-five necessary elements for life. Therefore, it is essential to understand of future marine ecosystems in regards to organic nitrogen influx. Here, the effects of increased atmospheric carbon dioxide on the nitrogen production capabilities of *Trichodesmium,* a marine cyanobacterium responsible for the majority of the nitrogen supply in its ecosystems, are measured. By taking advantage of the inverse relationship between pH and CO_2 absorption, *Trichodesmium* cultures were designed to grow in CO_2 conditions of the pre-industrial era, the current era, and predicted levels for the years 2060, 2180, and 2250. Per trichome, nitrogen fixation rates were found to sharply decrease by 2060 and level out for the future. Rates, accordingly to the results found, are the highest within the range of time studied. However, rates per mL were found to be in direct opposition, with rates increasing linearly from 2060 onward. Therefore, an increase in organic marine nitrogen influx can be expected to occur in the future if anthropogenic CO_2 continue to rise unabated. The consequences of this augmented nitrogen supply are unknown. The results from this particular research represent only one piece of the huge puzzle that constitutes the question of the effects of anthropogenic carbon dioxide on marine nitrogen cycles.

131 USING THE INHIBITORY EFFECTS OF ATP ANALOGS TO REGULATE MRNA PROCESSING: YEAR II

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A key element in gene expression, post-transcriptional processing proves to be essential for the vitality of a cell. Processing includes cleavage of the pre-mRNA and the addition of the poly(A)tail, which stabilizes the mRNA for transport outside of the nucleus in order to be translated into a protein. Defects in processing regulation are involved in diseases such as HIV/AIDS, thalassemias (a blood disorder), and can even play a role in tumor cell viability.

Recently, an *in vitro* coupled processing system that mimics processing *in vivo* has been created in our lab. During the development of this system, it was suspected that Cordycepin triphosphate (3'dATP), an ATP analog, inhibited cleavage and polyadenylation of RNA. This inhibitory effect implied that ATP might play an important role in mRNA processing.

To assess the role of ATP in mRNA processing, ATP analogs 3'dATP and Ara-ATP were introduced to coupled and uncoupled processing systems in pulse-chase assays. It was found that inhibition of processing was specific to ATP analogs. 3'dATP inhibited processing up to 25μM and Ara-ATP decreased processing efficiency by 43.5%. Data suggest that these ATP analogs interact at an allosteric site, thereby inducing a nonfunctional conformation, preventing processing. ATP interacts with proteins on the processing apparatus thereby regulating processing.

ATP-dependent regulation of cleavage and polyadenylation supports the new idea that the processing reactions are intertwined to efficiently express genes. In addition, harnessing this inhibitory effect from ATP analogs can be used to regulate over-expressed genes that cause diseases.

132 STUDY OF THE EFFECTS OF *NEURAL LAZARILLO* OVEREXPRESSION IN TRANSGENIC *DROSOPHILA MELANOGASTER*

Derek Tam. Alhambra High School. Mentor: Julien Muffat (laboratory of Pr. Seymour Benzer)

This project is aimed at discovering the effects of the overexpression of *Neural lazarillo (*NLaz) in *Drosophila.* Overexpression results in additional proteins of a certain gene being present in the organism. Previous research with a close homolog, *Glial lazarillo,* have led us to hypothesize that overexpression will increase lifespan and resistance to environmental stress. The human homolog of the two genes is Apolipoprotein D (ApoD). Its function is unknown, but it is upregulated in brain pathologies. We want to determine whether Nlaz can help slow aging in fruit flies or prevent neurodegenerative diseases, and gain a better understanding of ApoD in humans. I began by acquiring samples of Nlaz cDNA in plasmids, or bacterial vectors. Then the plasmids were transfected by electroporation into E.coli and several colonies were cultivated, replicating the vectors, which were then extracted by Miniprep. A restriction digest was conducted to cut out Nlaz. The Nlaz cDNA fragment was separated from the plasmid DNA by electrophoresis and will be cloned into the plasmid pUAST, which allows conditional expression in *Drosophila.* Once the final plasmid is constructed, it will be injected into *Drosophila* embryos. After careful selection we will obtain flies carrying the pUAST-NLaz transgene in their genome. These will be crossed to drivers to trigger the expression of NLaz with spatio-temporal control. I will test the progeny for increased lifespan and resistance to stresses (e.g. heat, hyperoxia). Results from this project will help us understand the role of ApoD in human aging and neurodegeneration.

133 3D MODEL OF ALGORITHM PERFORMANCE ON THE 3-SATISFIABILITY PROBLEM

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The Satisfiability problem consists of variables with two solutions: True or False and clauses comprising of variables connected through OR operators. In some instances, NOT operators are situated at the front of variables, negating variables. All clauses are further linked to one another using AND operators.

Using two algorithms, a model is created to analyze the performance. The two algorithms are the simulated annealing algorithm and a variant of the simulated annealing algorithm. These two algo-

rithms were chosen because of its extremely high performance compared to the hillclimbing and genetic algorithm.

Due to the diversity of satisfiability problem, the experimentation was tested with a ratio of approximately 4.25:1. This creates a equal divide in solvable and unsolvable problems. The experiment was tested on three problems consisting of four variables and ten clauses. It is then modeled to analyze its performance on a small scale in order to incorporate it into larger scale problems.

The satisfiability problem is significant in many ways because of the NP-complete nature of the problem. By generalizing an efficient way to solving this problem, it can be applied to problems that have the same NP-complete property.

134 PROSTATE CANCER PREVENTION BY POLYPHENOLIC COMPOUNDS IN GREEN TEA

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Cancer is known to be one of the leading causes of death, and of those deaths, 40,000 cases are attributed to prostate cancer. In this study of chemoprevention for cancer, RWPE-1 prostate epithelial cells were used in conjunction with epigallocatechin gallate (EGCG), which is a major polyphenolic compound of green tea. Very recent studies have shown that green tea might possess factors, especially certain polyphenolic compounds, that would further the research for chemoprevention. In this particular experiment, EGCG is speculated to be able to inhibit protein kinase C (PKC), which is a receptor for tumor promotion. The RWPE-1 precancer cells were infected by EGCG and grown in soft agar. The cells then underwent several scintillation counter exams. Each test was aimed to find distinct data and results that proved EGCG could indeed inhibit PKC. The correlation between the concentration of EGCG used and the number of active cells and colonies supports this experiment's hypothesis and further confirms recent queries about the possibility of using green tea for future chemoprevention.

135 IMPORTANCE OF DROSOPHILA EIF4E-BINDING PROTEINS IN LIFESPAN REGULATION

Tony Au Lu. Alhambra High School. Mentor: Brian M. Zid; Teacher: Mr. Duane Nichols

Aging is unclear to scientists worldwide and yet people continue to be interested in ways to live longer; in Drosophila, when insulin levels fall, due to either genetic interventions or lack of nutrients a lifespan extension is seen. My previous research suggests that longer lifespan correlates with activation of the dFoxo gene, which is regulated by insulin levels, and reduced amounts of nutrients. This project therefore tests whether or not 4E-BP, which is downstream of the dFoxo pathway, is responsible for the increase in lifespan. Thus, it is hypothesized that if there is a lack of nutrition and if 4E-BP is upregulated, then 4E-BP will stimulate an increase in lifespan. In this study, Drosophila lifespan was studied with respect to various overexpressions of 4E-BP that differ in their composition of Gal4—PO163, or 109—drivers, which are Drosophila lines that express the yeast transcriptional activator Gal4 in a tissue specific manner. In addition, the Drosophila were fed protein in the form of yeast ranging from 0–4% yeast concentrations. I saw complex interactions between the levels of 4E-BP and the nutritional content of the food for the phenotype of lifespan. The results show overexpressed 4E-BP on low yeast has a 50% increase in lifespan while 4E-BP on high yeast, a 15% decrease in lifespan. Because the Drosophila genome shares 77% of their genes with the human genome, these findings may be applied to increasing human lifespan and allow us to study human mortality.

136 MOTHER'S CHARACTRISTICS AND HER CHILD FEEDING HABITS

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Obesity is one of the fastest growing public health problems in America. It has been established that weight problems in childhood lead to significant health problems later in life. Parents are the strongest and most direct influence on their children's eating habits, and eating habits that are established in childhood often persist through adulthood. By surveying mothers of diverse ethnic and socioeconomic backgrounds, correlations can be found that indicate which characteristics possessed by the mother influence her child feeding habits.

Several such variables have been studied by the use of surveys. The socioeconomic status of the

mother, her depression, body dissatisfaction and acculturation all affect her feeding habits and thus her child's eating habits. Her influence is determined by considering her restriction of her child's eating, the pressure she places on her child to eat, her perceived feeding responsibility, her concern about her child's weight and how closely she monitors her child's eating. The study found that there is a positive correlation between the socioeconomic status of the mother and the pressure she puts on her child to eat. There were also negative correlations found between her acculturation to American society and her perceived child feeding responsibility and, again, the pressure she puts on her child to eat. These findings are important to discovering which mothers are more likely to misguide their children's eating habits and how mothers can be educated in helping their children make intelligent eating decisions for the rest of their lives.

137 ROLES OF AUXOTROPHIC MARKERS IN *CANDIDA ALBICANS* VIRULENCE

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Candida albicans is the most common human fungal pathogen that causes mucosal and disseminated infections. This dimorphic fungus, which exists as oval, single yeast cells but forms hyphae under favorable conditions, is the most common cause of yeast infections. The virulence factors, which determine the ability of *C. albicans* to cause damage to its host cells, will serve as promising targets for therapies against *Candida* infections. Therefore, we examined the nutrient auxotrophy as a potential modifier of virulence in *C. albicans.*

In order to determine the effects of auxotrophy for uracil, arginine, and histidine on virulence traits of *C. albicans,* BWP17 ($Ura^-Arg^-His^-$) strain was used as a parental strain to construct $Ura^+Arg^-His^-$ strains, $Ura^+Arg^+His^-$ strains, and $Ura^+Arg^+His^+$ prototrophic strains. To examine the ability of each newly created strain to express the virulence related traits, growth test on different selection media, hyphal formation, and endothelial cell damage assay were performed.

$Ura^+Arg^-His^-$, $Ura^+Arg^+His^-$, and prototrophic strains formed hyphae while BWP17 could not. The abilities of the newly constructed strains, which all are prototrophy for uracil, to cause damage to endothelial cells were significantly higher than that of BWP17. Therefore, prototrophy for uracil is essential for the full virulence traits of *C. albicans.* On the other hand, auxotrophy for arginine and histidine does not affect the virulence traits. In conclusion, inhibiting the production of uracil may be used to develop therapeutic agents that specifically target *Candida* infections.

138 PREDICTING MATERIAL FAILURE: CORRELATION BETWEEN DEFORMATION LUMINESCENCE AND HYSTERESIS

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Prediction of material failure would advance solid-state physics and revolutionize modern engineering. Scientists and commercial systems, currently, are unable to measure the impact of stress and, most importantly, to predict system failure. The objective of this study is to discover the molecular changes of materials under stress by analyzing the characteristics of deformation luminescence (DL). Such discovery leads towards the ultimate goal of predicting material failure.

Mechanoluminescent irradiated Lithium Fluoride (LiF) crystals were utilized in various experiments to investigate deformation luminescence as the material undergoes hysteresis, specifically the variables of stress, strain, load speed, and time duration. An Instron testing system was used to compress LiF at various loads, speeds, and cycles. Photomultipliers were used to capture photon emission data. Data was collected both manually and with an oscilloscope computer data acquisition system. Mathematical models were derived.

As LiF was stressed beyond its elastic limit, light was found to increase drastically in various mathematical functions against stress, strain, and time duration, signaling hysteresis. DL increases logarithmically to load speed. Accumulative total of photon emissions was found to be an accurate assessment of material health. DL was also found to be effective in detecting the presence of internal cracks and denoting the phenomena of fracture.

DL was found to be a superior indicator of hysteresis, the precursor to failure. The discoveries made in this study form the basis of a reliable failure prediction system. The findings will ultimately improve the safety and efficiency of vehicles, machines, and structures we use today.

139 CHANGES IN DENSITIES OF FECAL INDICATOR BACTERIA (FIB) OVER DIFFERING TIDAL FLOWS IN THE BALLONA WETLANDS, LOS ANGELES

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There are two main objectives of this experiment: 1) to create a mathematical model showing the relationship between turbidity, dissolved oxygen, pH, salinity, time from high tide, and levels of indicator bacteria for fecal contamination, and 2) to see if fecal indicator bacteria (FIB) densities differ with tidal flows from flood to ebb.

In the field samples were tested at a single location every half hour during 12-hour periods on 3 occasions for temperature, dissolved oxygen, and pH levels using the YSI 600R Sonde Electronic Probe. In the laboratory, turbidity was measured using a HACH 2100N turbidity meter, and densities of FIB (total coliforms, *E. coli,* enterococci) were determined using IDEXX Quantitray 2000 test kits and reagents based on enzyme substrate methods. A mathematical model was created showing the relationship between dissolved oxygen, turbidity, pH, salinity, time from high tide, and bacterial growth.

Results indicated that bacterial levels were higher with decreased dissolved oxygen, decreased salinity, and increased turbidity in a neutral pH. As bacterial levels rose, the dissolved oxygen and salinity reserves were depleted. Turbidity levels appear to increase as sediments are drawn off of the banks of the water column and resuspended from the bed of the creek. FIB appear to attach to the sediment particles, thus are drawn into the water as turbidity increases. FIB levels were also higher at and around high tide. This study suggests that sophisticated mathematical models can be constructed to integrate testing parameters. As more v ariation around these parameters is explained through modeling, then fewer key parameters could be measured in the future, thus reducing the costs for monitoring programs.

140 POLYPHENOL EFFECT ON SUSCEPTIBILITY OF OXIDIZED β-AMYLOID PEPTIDE TO INSULIN DEGRADING ENZYME

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Oxidized amyloid-β proteins (Aβ) play an important role in the pathogenesis of Alzheimer's disease and are the cause of neuronal deaths. This study tested whether polyphenols, antioxidants in green tea, had an effect on the susceptibility of oxidized Aβ to protease digestion by insulin-degrading enzyme (IDE), a major Aβ-degrading enzyme. 2 sets $A\beta_{40}$ peptides were oxidized with NBS and $Cu{+}{+}/ H_2O_2$ in either green tea extract, a major source of polyphenols, or aqueous solvent. The Aβ peptides were lyophilized and resuspended and then desalted using C18 spin columns. A BCA protein assay was used to determine the recovery of Aβ from the columns. Green tea and non-green tea incubated $A\beta_{40}$ were subjected to proteolysis with IDE or trypsin. Aβ samples were electrophoresed and were analyzed by Western Blot and the results were captured on x-ray film. This study concludes that IDE and trypsin's proteolytic ability towards oxidized $A\beta_{40}$ incubated in green tea are increased as compared to standard oxidized $A\beta_{40}$. Both enzymes also exhibited increased proteolsis towards the $A\beta_{40}$ peptides when higher concentrations of enzymes were added to the sample. Polyphenols in green tea were able to reduce or prevent the oxidation of $A\beta_{40}$, thus allowing enzymes to degrade the peptides without complications.

141 EFFECTS OF SALINITY CONCENTRATION ON RATES OF POLYP CLONING, GROWTH, AND STROBILATION IN THE *AURELIA LABIATA* (CNIDARIA, SCYPHOZOA)

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The purpose of this study was to determine how increased and decreased salinity concentrations affect the developmental asexual stage in the life cycle of the *Aurelia labiata.* This species of jellyfish is known to be adaptable in the changing marine environments of coastal ecosystems, but environmental factors could influence their reproduction rates. After culturing from fertilized eggs, 10 similarly

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